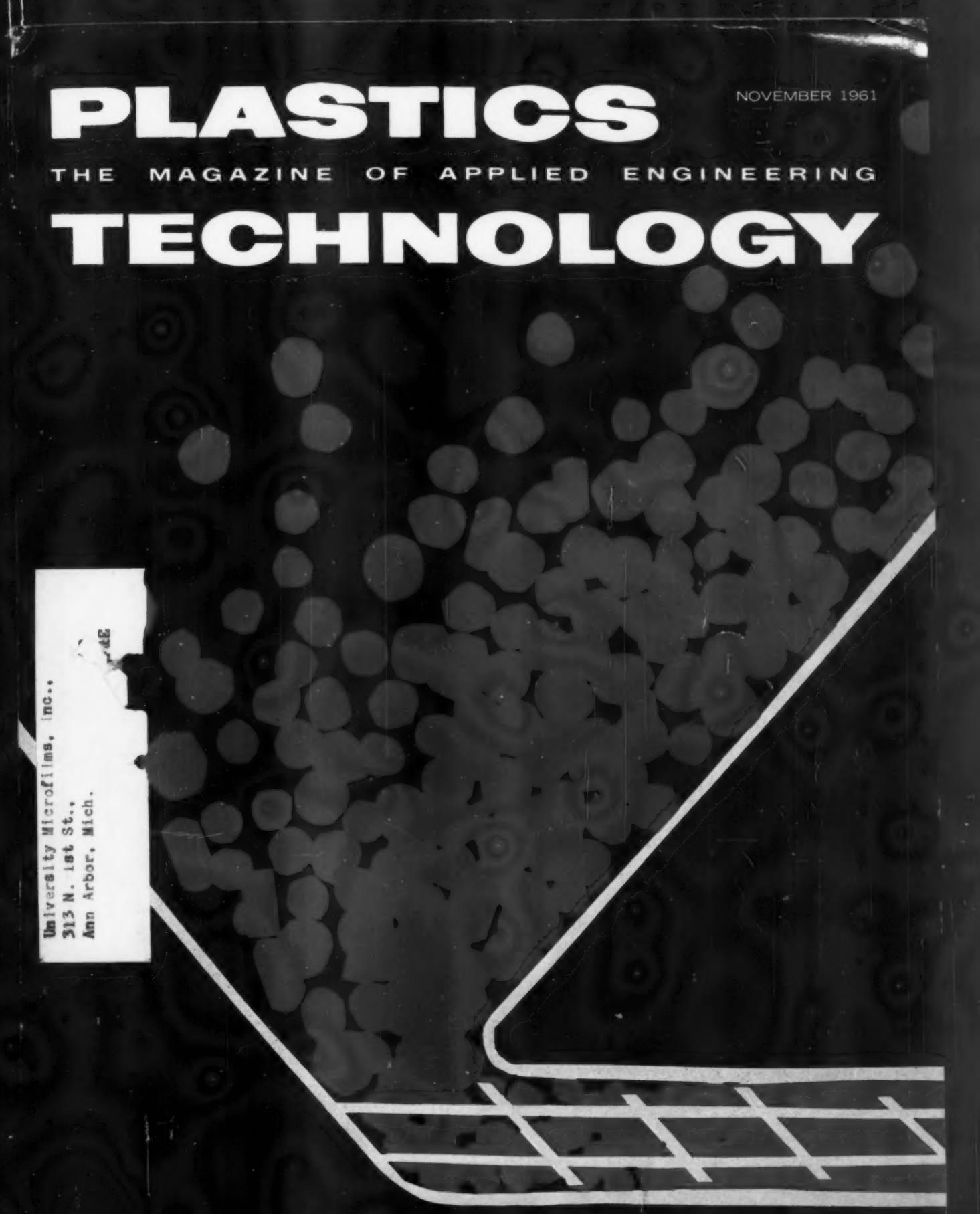
PLASTICS TECHNOLOGY

NOVEMBER 1961

THE MAGAZINE OF APPLIED ENGINEERING



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EXTRUSION AND BLOW MOLDING MACHINES 1961

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extruders are the tonnage pacesetters of the thermoplastics industry. They are finely controlled and fully equipped with automatic devices — your engineers will vouch for STERLING'S superb instrumentation.

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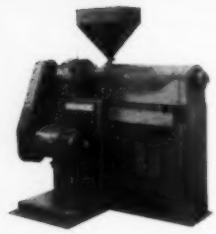

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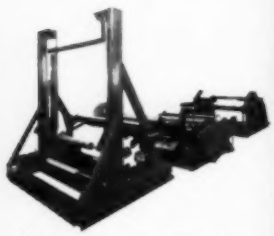

Laminators up to 96" width, complete with unwind section, laminating section and rewind section. Automatic or manual splicing. Film or sheeting dies available up to 96" in width.

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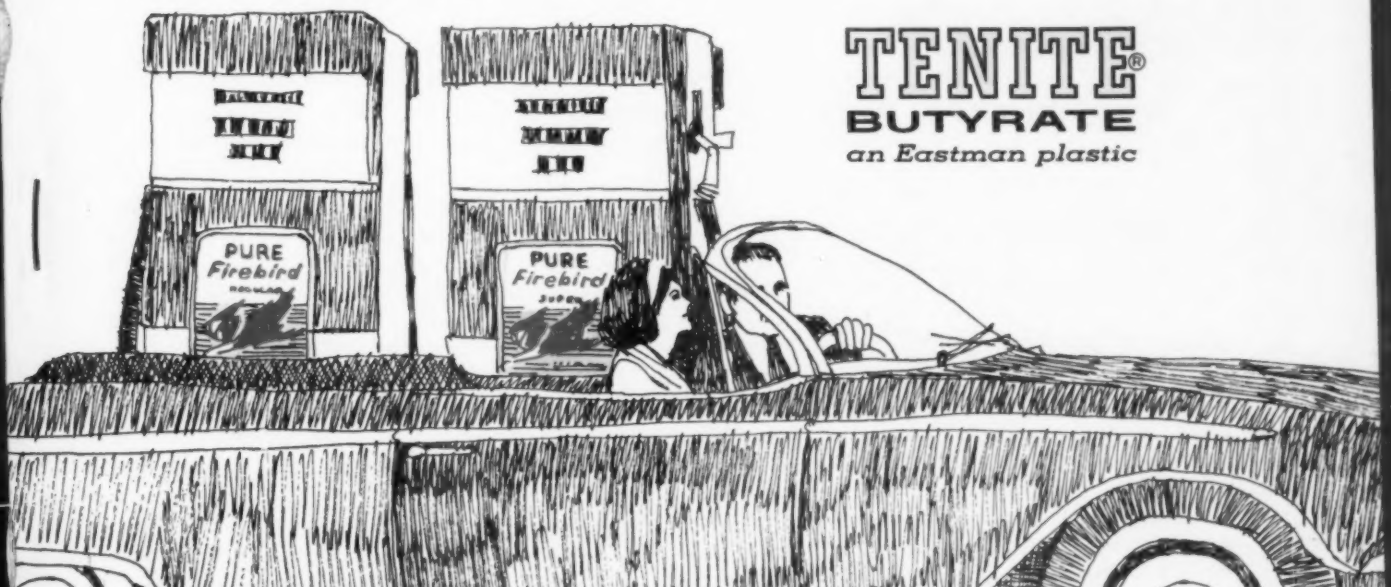

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PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

November 1961, Vol. 7, No. 11

feature articles:

MOLDING VINYL FOOTWEAR **p.39**
by Gilbert J. Darcy
Processing operations described include slush molding of the plastisol formulation to make the skin, and low-pressure injection molding of the sole and foxing. The topic of model making using an electroformed mold is also covered.

RIGID URETHANE FOAM—PROCESS VARIABLES AND TEST PROCEDURES **p.43**
by R. E. Jones
The conc'usion of a comprehensive two-part article on the variables involved in making rigid urethane foam for low-temperature insulation. This section describes test methods.

special section:

EXTRUDERS **p.53**
The machines currently available, their specifications, and a guide to choosing them.

P.T.'S COMPARATIVE DATA ON 1961 EXTRUSION MACHINES **p.57**

P.T.'S COMPARATIVE DATA ON 1961 BLOW MOLDING MACHINES . **p.63**

P.T.'S CLASSIFIED LIST OF 1961 AUXILIARY EQUIPMENT FOR EXTRUSION & BLOW MOLDING **p.66**

LETTER FROM THE PUBLISHER **p.67**

guest editorial:

EXPECTED CHANGES IN EQUIPMENT AND THEIR EFFECTS ON YOU **p.68**

exploring fabrication techniques:

RADIO FREQUENCY MOLDING OF EXPANDABLE POLYSTYRENE . **p.72**
by L. J. Zukor

engineering forum:

COMPRESSION & TRANSFER MOLDING **p.74**
by Paul E. Fina
Don't forget the melamines!

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Letters to the editors

Sirs:

Just a word of appreciation for the Guest Editorial in the July issue, "What Has Happened to the Shirtsleeve Image?"

The writer, Chaylie Saxe, is a total stranger to me, but his ideas are compellingly interesting and practical. He is to be commended for his business accomplishment, but more so for the perspective and insight into the problems of small business in general.

I'm not given to writing editors, but this kind of writing should be encouraged. Thank you for printing it.

John C. Louer
703 Greenwood Rd.
Wheaton, Ill.

(Thank you, Mr. Louer, and the many other readers who have expressed their interest in and appreciation of this article. The letters received in response to this editorial have been most gratifying.—Ed.)

Instruction Manuals

Sirs:

Thank you for printing Mr. Rubin's article, "What's Wrong With Machine Instruction Manuals" (August issue, p. 33). Although we cannot agree with all he said, we appreciate the time he took to try and help us to do our job better. The article was well planned and well written. May we see more on the subject in future issues.

Joseph G. Zygmut, Jr., Chairman of Chapter, Rochester Chapter, Technical Writers and Publishers Rochester, N. Y.

Plastic Testing Laboratory

Sirs:

We have interests in setting up a plastic evaluation and testing laboratory.

Have you had articles in your journal that suggest general equipment and methods necessary for testing plastics at laboratory levels.

O. L. Bertorelli, Chemicals Div.
J. M. Huber Corp.
Havre de Grace, Md.

(Such articles have appeared and were suggested, with issues noted in a separate letter.—Editor).

Vinyl floor tiles

Sirs:

As subscribers to your publication PLASTICS TECHNOLOGY, we have derived a good deal of useful information from its pages.

At the present time, we are in need of any possible information you may have concerning the utilization of vinyl materials in floor tiles. We are particularly interested in the formulations for such tiles, and in machinery used in their manufacture.

Robert S. Miller
J. J. Berliner & Staff
New York 12, N. Y.

(Those willing to supply the information Mr. Miller desires can contact him at 684 Broadway or ORegon 3-7550.—Ed.)

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

Articles on schedule

The Outlook for 1962. How key men in the plastics industry view the coming year. A staff-written report summing up statements and predictions from the different branches of the industry—materials suppliers, equipment manufacturers, molders (thermosetting, thermoplastic, and reinforced plastics) and extruders, film and sheet manufacturers, and tool and mold makers.

•

An Introduction to Designing With Plastics. A two-part article dealing with the problems often encountered with plastics and their behaviors in practical engineering applications. The main purpose is to point out specific engineering areas which frequently cause design headaches when overlooked, and to recommend areas in which materials research should be conducted.

•

Polychlorotrifluoroethylene Infrared Optical Components. Components having adequate transparency in the lead sulfide infrared spectral region can be made by cold forming sheet stock for flat window applications, and by compression molding with simultaneous quenching for deeper domes and meniscus lenses.

•

Button Panels of Polyester. Discussion of methods for making polyester laminate panels. These, in turn, can be punched out for form buttons.

•

Design Manual for Joining of Glass-Reinforced Structural Plastics. This Manual is arranged to assist the designer at the point where the designed item has been analyzed for loads and the materials of construction have been selected. Next comes assembly of components in an all-plastic or metal-plastic structure. This involves joining of structural members. This Manual permits design of joints capable of transmitting specified loads.

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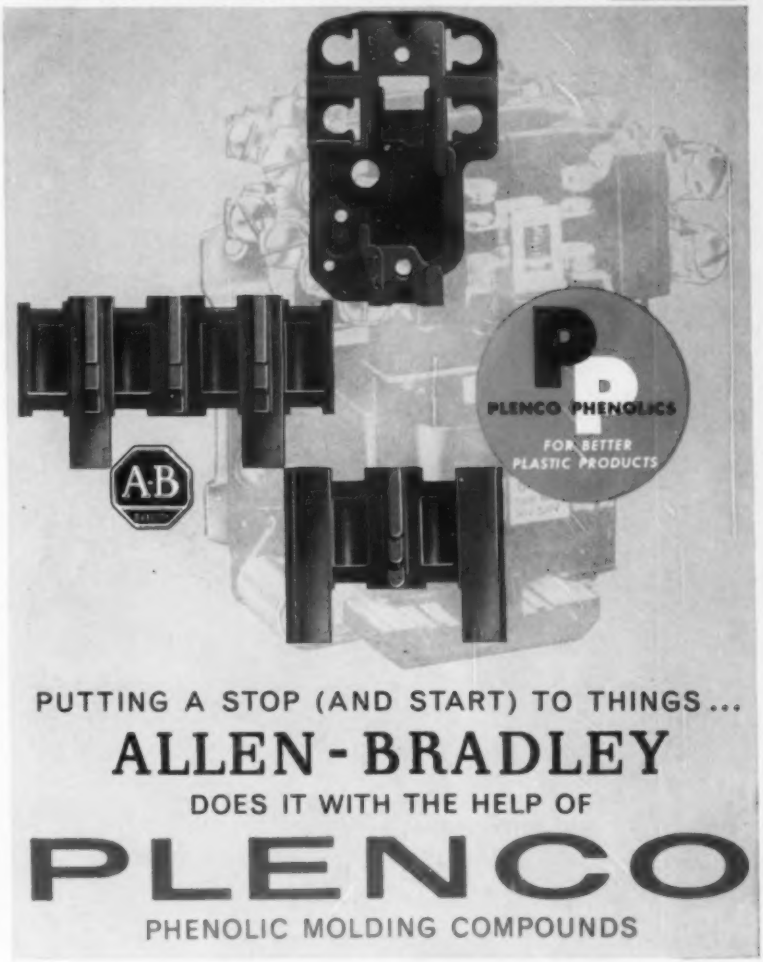

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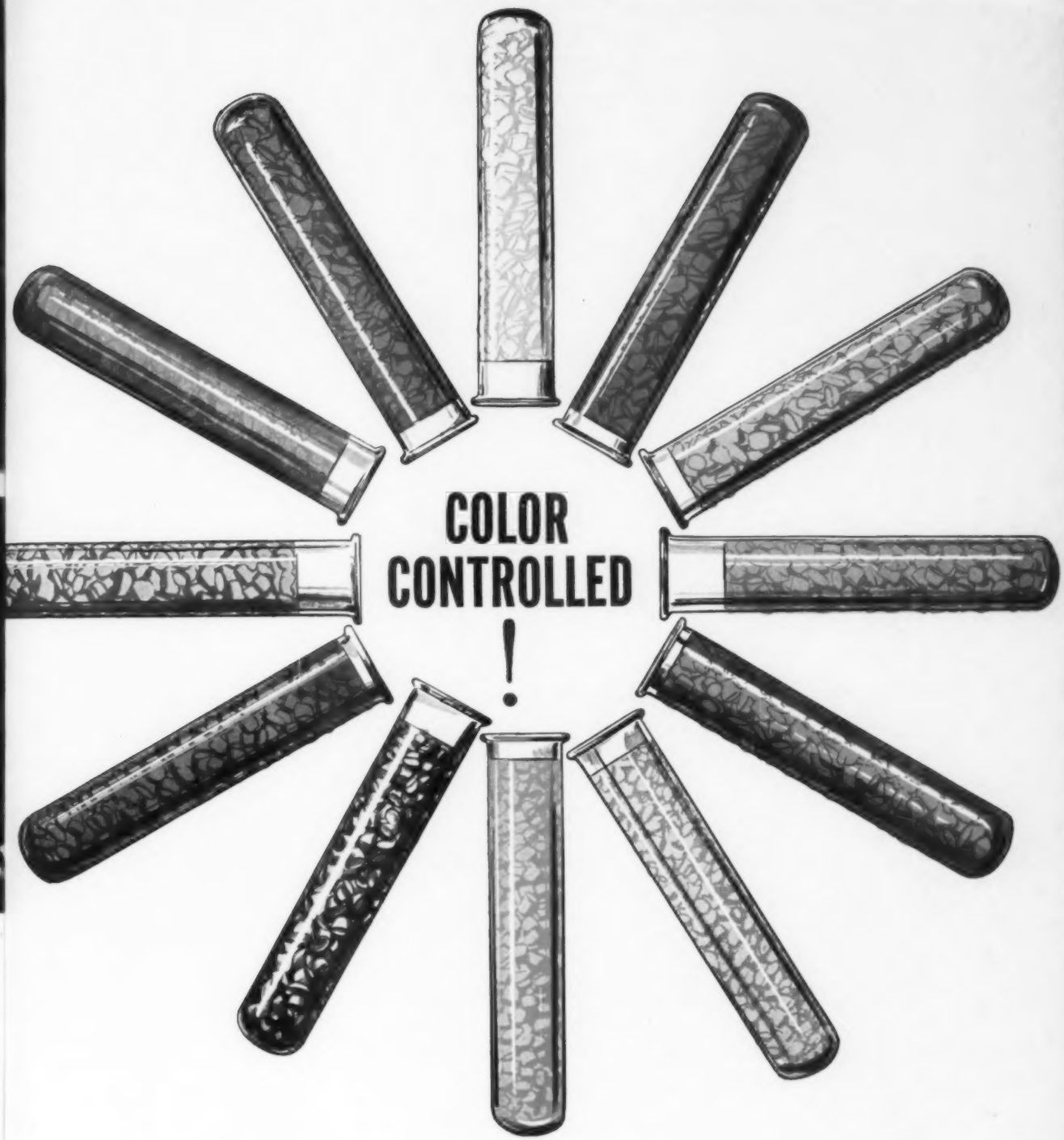

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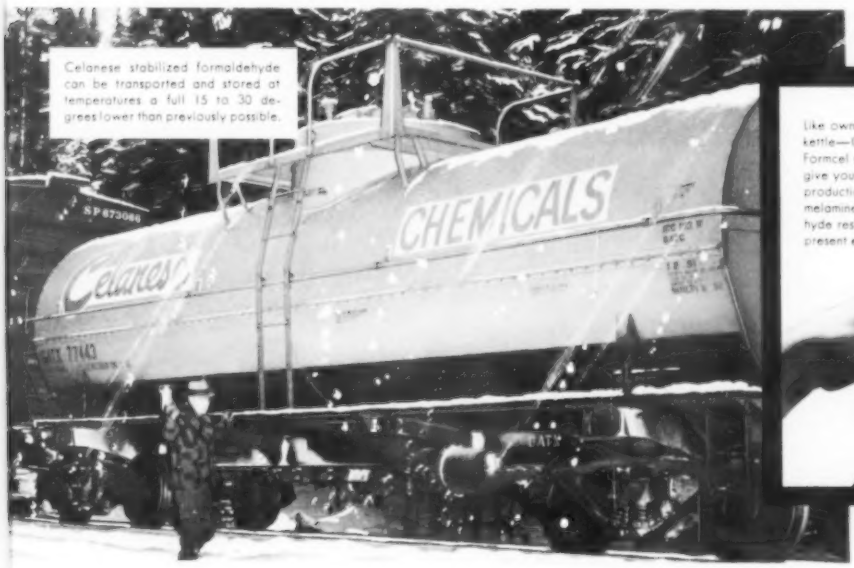
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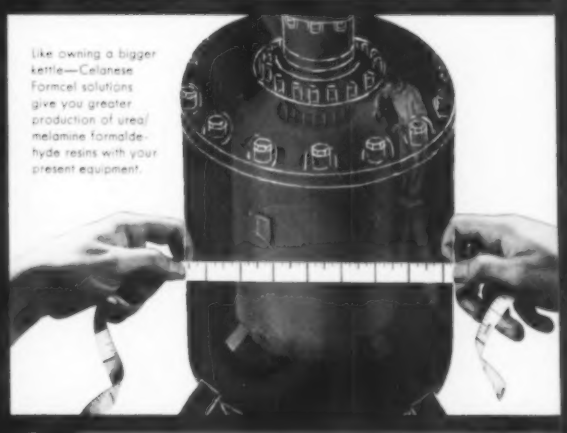
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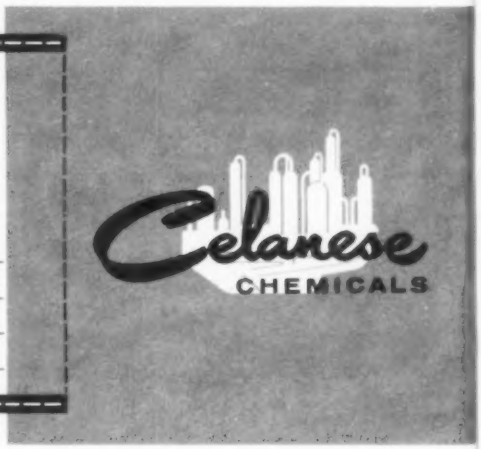

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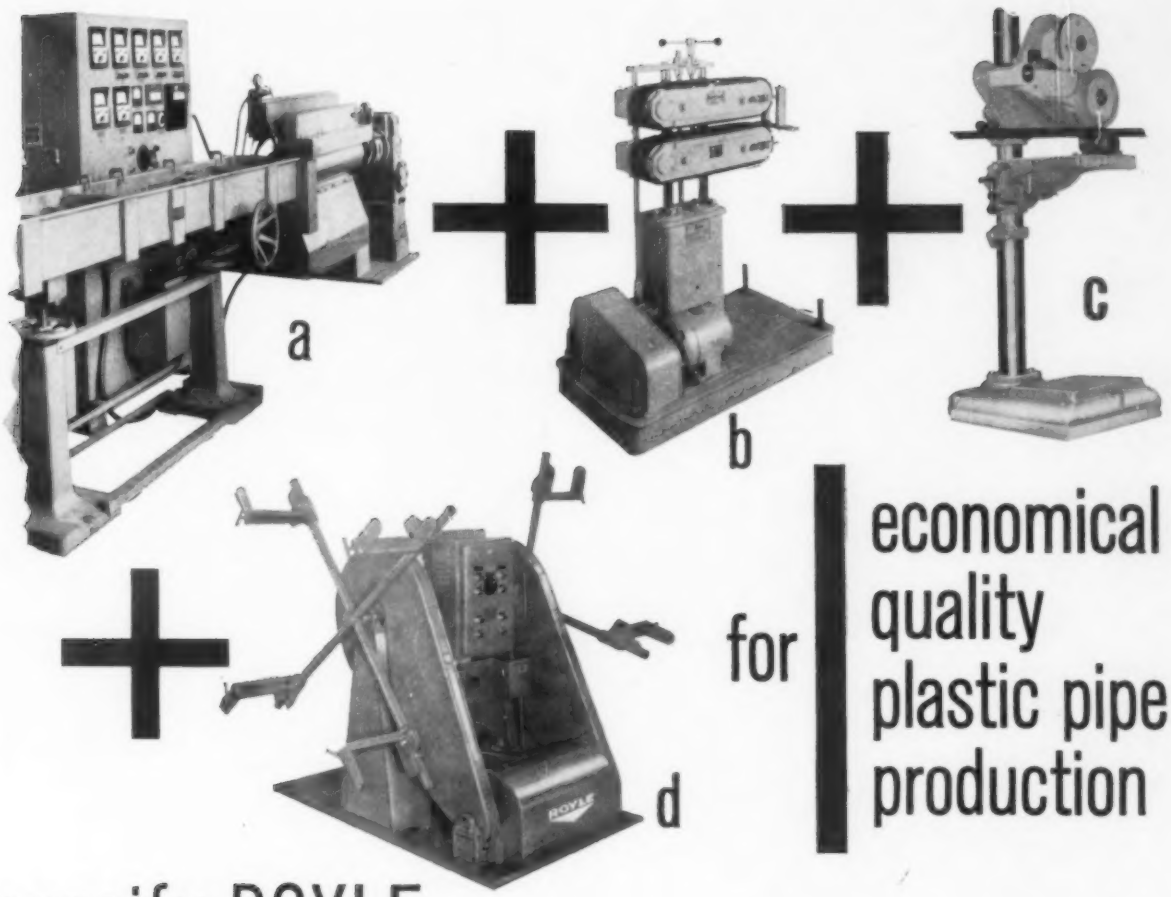

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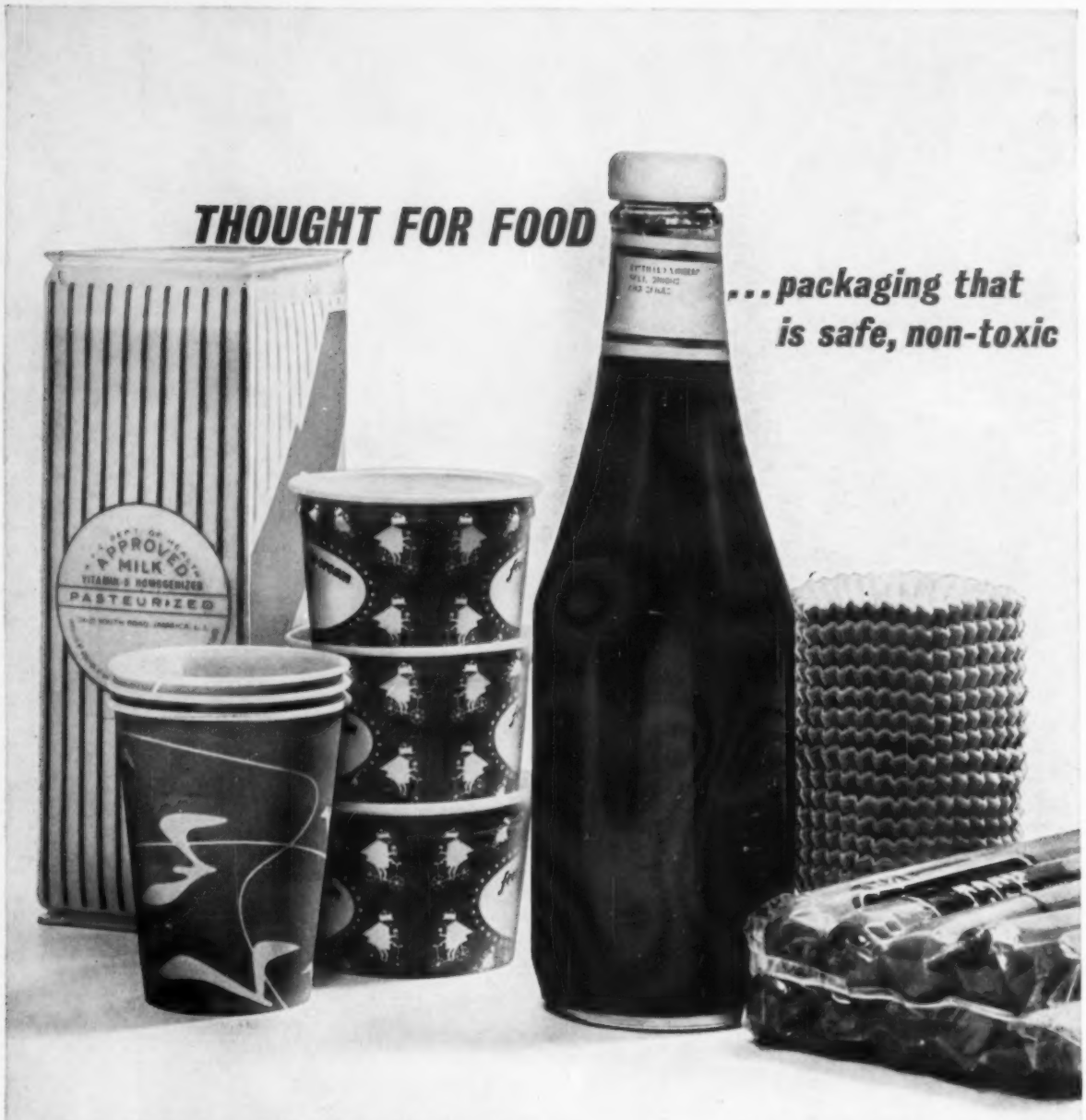

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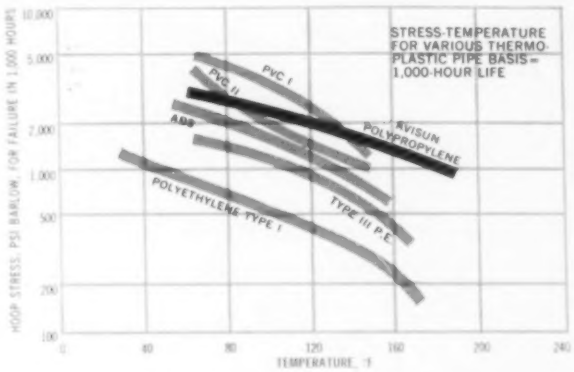

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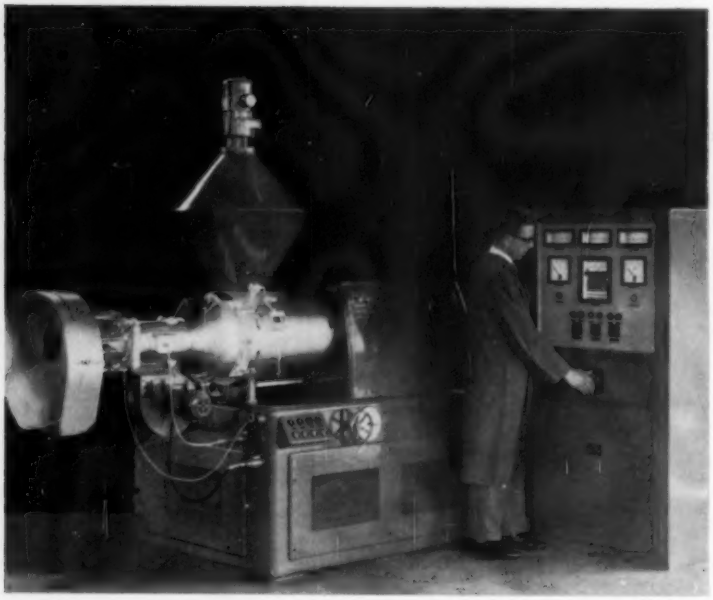


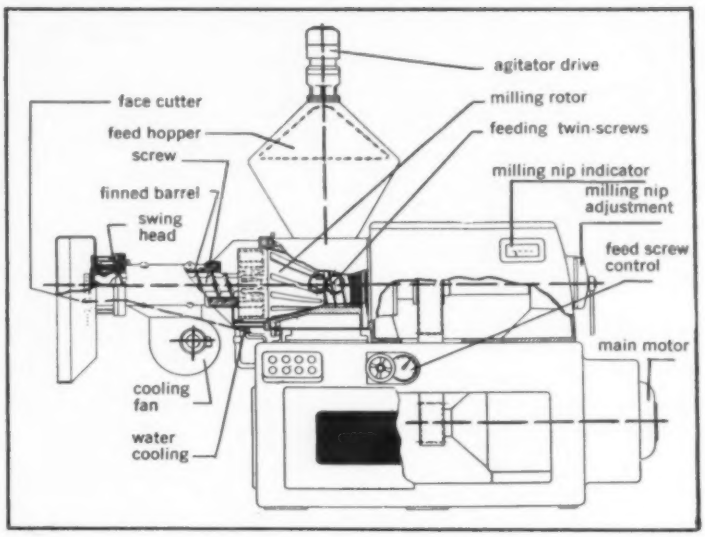
mills the preblend to greater homogeneity by passing each particle through the circumferential milling nips with the same frequency and for the same time

generates exactly the required heat by shearing stresses within the PVC controlled by stepless adjustment of the milling nips to the desired stock temperature during operation.

reduces the heat history by a shorter residence time for all particles, thus often saving half of the stabilizer

removes moisture from the preblend

densifies and extrudes the PVC at lowest temperatures into pellets of regular shape obtained by face-cutting, strand pull-off or strip dicing, at output rates of 400 to 600 lbs/hr



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EVALUATION OF BRITTLE FAILURES OF POLYETHYLENE

Polyethylene may fail at unusually low stress levels when exposed to certain surface active agents. These failures, commonly called stress cracks, are usually characterized by sharp conchoidal fractures in regions of the article that have been subjected to relatively high levels of sustained polyaxial stress.

One method of testing brittle failure provides a means of controlling reproduction of conditions typical of field failure. This method makes use of a specimen of polyethylene cut in the shape of a Maltese cross (Fig. I), which is stressed biaxially. Test environment is applied to both the upper and lower surfaces of the specimen center. Time from initial exposure to the reagent to initiation of cracking is recorded as the independent variable. This test method provides for control of the significant variables, and eliminates the factor of creep. It also eliminates premature failure due to edge imperfections.

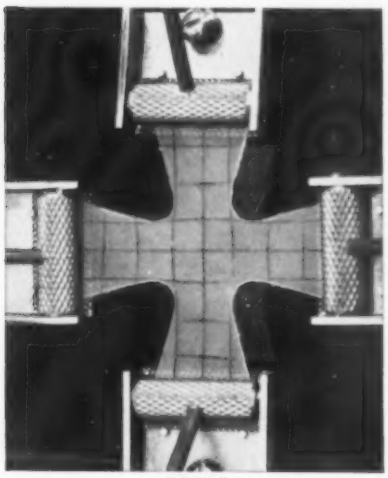

FIGURE I

In this study of factors which might influence the useful life of polyethylene, the environmental variables of stress and temperature and the material variables of density and melt index were found to be significant.

As expected, stress level was found to be important in determining failure time. It is equally important that this stress be uniform throughout the test, and be unaffected by secondary influences such as creep.

A significant interaction was found between temperature and melt index. Though the effect of temperature on test results is as expected, the influence of the interaction should be considered in any attempt to accelerate results by elevating test temperatures.

Reagent concentration has a definite effect on failure time, but only in the concentration range in which interfacial tension between reagent and specimen is changing. Above this range, increasing concentration has little effect on failure time. For example, data for all concentrations above 3% reagent in water fall on the 100% curve.

Figures II, III and IV illustrate the influence of melt index on failure time of polyethylene specimens of varying densities. In low density materials, the effect of melt index is very pronounced. In fact, materials with densities of 0.916 and melt indices of less than 8.0 do not show brittle failures in reasonable periods of time by this method. When the stress level is increased on such materials, ductile failure occurs before brittle failure begins. Thus, the transition in the mode of failure for such materials is in the room temperature region.

Full details and data on the study, of which this is only a partial report, are available on request by designers and plastic engineers. Dow Plastics Technical Service Engineers are engaged in continual studies on all aspects of finishing, molding and design of plastics parts. For information, write THE DOW CHEMICAL COMPANY, Midland, Mich., Plastics Sales Department 1735DT11.

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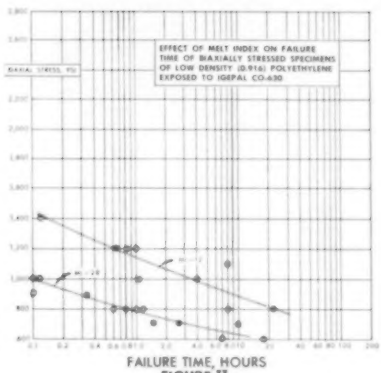
EFFECT OF MELT INDEX ON FAILURE TIME OF BIAXIALLY STRESSED SPECIMENS OF LOW DENSITY (0.916) POLYETHYLENE EXPOSED TO IGEPAL CO-630
FAILURE TIME, HOURS

FIGURE II

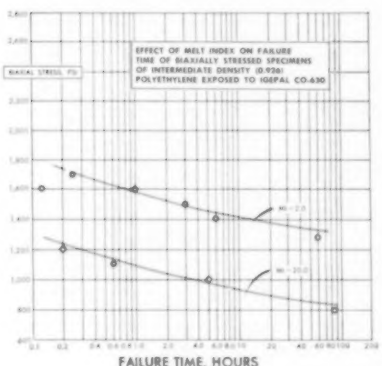
EFFECT OF MELT INDEX ON FAILURE TIME OF BIAXIALLY STRESSED SPECIMENS OF INTERMEDIATE DENSITY (0.926) POLYETHYLENE EXPOSED TO IGEPAL CO-630
FAILURE TIME, HOURS

FIGURE III

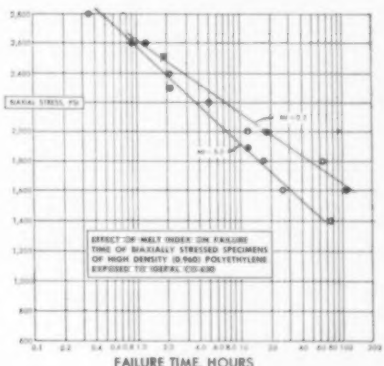

FIGURE IV

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

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What's New in Processing

The feeding of reground polyethylene scrap into a pelletizer is made more uniform by the use of a Vibra Screw Feeder and thus material losses in the reclamation process are reduced to approximately 5%, according to tests run by the development department of Waldron-Hartig Division, Midland-Ross Corp., and reported by E. A. Wahl, president, Vibra Screw Feeders, Inc. Plastic extruders experience about 15% waste in extruding polyethylene film. In regrinding and reforming the scrap film into pellets for further extrusion, the reground film has a tendency to agglomerate and pack but the vibration of the feeder fluffs the material which then flows evenly and accurately, into the pelletizer at rates up to 200 pounds an hour.

A new and unique method for lining flexible and non-flexible metal tubes with Teflon to assure frictionless movement of push-pull control cables and flexible drive mechanisms has been developed by Timely Technical Products, Inc. Teflon's antistick, frictionless properties as well as many other desirable properties make it well suited for lining control cables. Timely Tech's facilities permit extrusion of linings to meet most I. D. and O. D. tolerances to insure "no-creep" fit and yet provide frictionless movement for rotating shafts or push-pull control cables.

Abstracts

"Injection Stamping to Compensate for Shrinkage," by J. Wallner, Plastverarbeiter, June 1961, describes a method for uniform compensation of shrinkage of injection molded polymethacrylate parts having thick walls and unevenly distributed wall thicknesses, in which the first stage of the usual injection process is followed by a kind of die-stamping operation effected by moveable core dies built into the mold. (In German).

"Teflon, for Operating Temperatures Up to 260°C.," by H. H. Reinsch, Plastverarbeiter, June 1961, offers practical suggestions for machining, drilling, boring, sawing, grinding, etc. of Teflon components. (In German.)

"Advances in Dry Blend Extrusion," by N. T. Flathers, R. E. Johnson, V. R. Pallas, and W. Mayo Smith in Modern Plastics, May 1961, describes developments in the technology of the extrusion of filled and unfilled PVC formulations from dry blends with the aid of a vacuum hopper, which when used with extremely fine mesh screens, has made possible the extrusion of PVC products of excellent quality.

"Extrusion," by Harold E. Sponaugle in Plastics Design & Processing, June 1961, discusses extrusion in broad terms with emphasis on the selection of equipment, with special reference to the cylinder, screw, automatic valving, drives, heating and cooling systems, and control panels.

"The Spray-Up Process—Promising Fabrication Technique," by C. E. Hayes, SPE Journal, June 1961, describes the advantages and disadvantages of the spray-up process, i. e., the simultaneous deposition of promoted resin, catalyzed resin, and reinforcing material, in terms of processing, economics and end product characteristics.

Patents

2,985,915 to Hedwin Corp. A method and apparatus for thermoforming from a heated sheet of thermoplastic material, hollow articles having controlled thicknesses distribution, by means of superimposed discs between mold head and base.

2,985,918 to Raybestos-Manhattan, Inc. A process for forming shaped lengths of cellular tetrafluoroethylene by mixing unsintered, finely divided tetrafluoroethylene polymer with finely divided methyl methacrylate polymer containing voltile organic lubricant and heating to sinter the former and decompose and volatilize the latter.

2,986,076 to W. R. Grace & Co. A machine and method for forming containers sealed at one end from flexible tubing.

2,986,536 to Allied Chemical Corp. A process for coloring polyurethane foams by use of the water in the pigment filter cake for reaction with the isocyanate to form the carbon dioxide for foaming.

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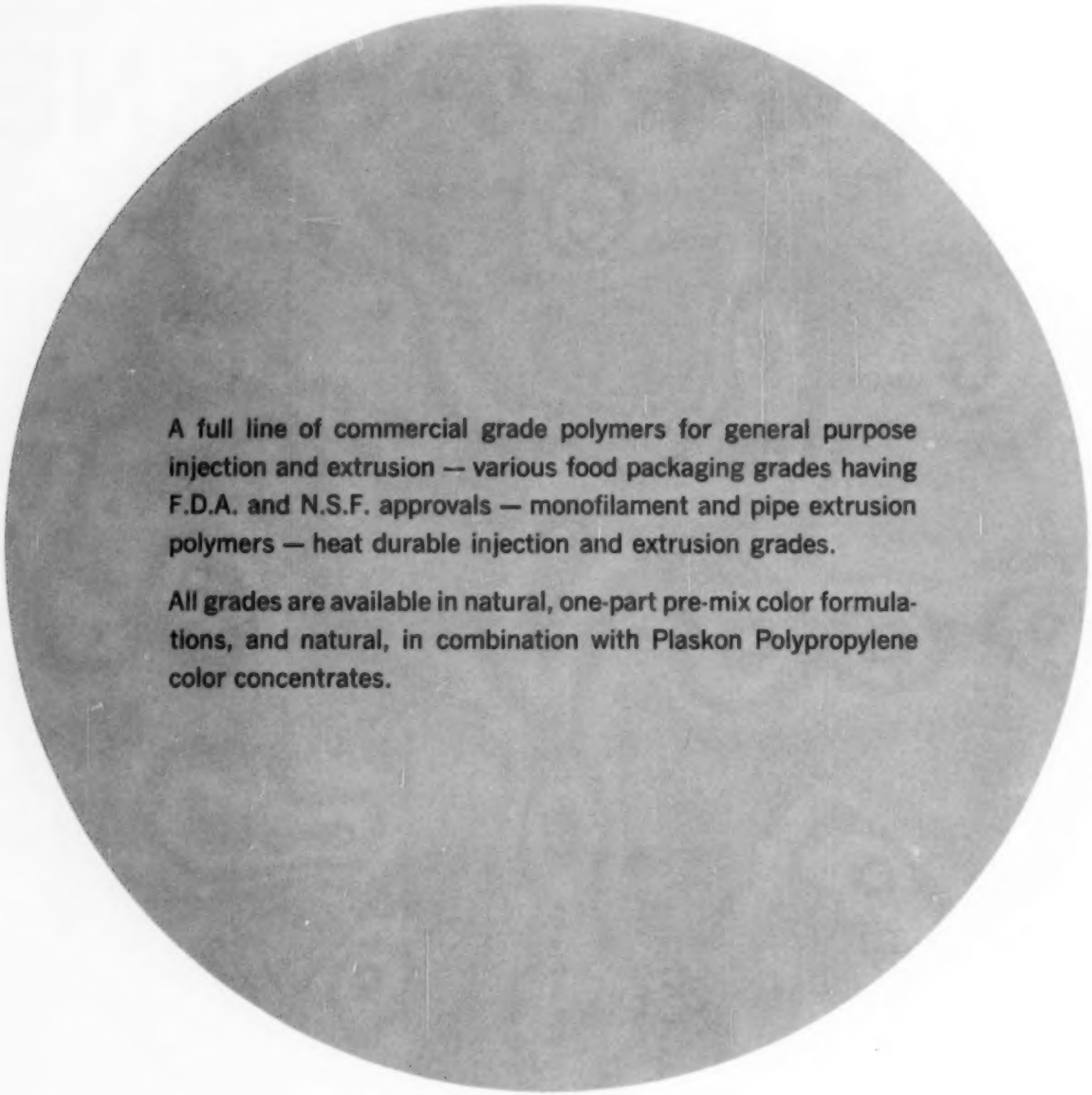
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Plaskon Polypropylene offers a valuable combination of properties. Easy to mold, this plastic is so light, it floats on water, so super resilient it can be flexed for years without fatigue or breaking. In addition, Plaskon Polypropylene is more resistant to high temperatures than most other commonly used thermoplastics. Other important properties include: low permeability to water, vapor, and solvents; excellent resistance to creep and environmental stress cracking; rigidity; high impact strength.

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PROPERTIES OF PLASKON POLYPROPYLENE

Properties & Conditions	ASTM Test Method	Units	Value
Density	D-792-60T	GM/ML	0.91
Melt Flow Rate, 230°C., 2160 GM. Load	D-1238-57T (Modified)	GM/10 Min.	0.3-7.5[1]
Mechanical (At 73°F.)			
Tensile Yield Strength At 2 IN/MIN	D-638-60T	PSI	4900
Ultimate Tensile Elongation At 2 IN/MIN	D-638-60T	%	250
Stiffness—Flexural	D-747-58T	PSI	150,000
Impact Strength, Izod	D-256-56	FT/LB/In Notch	0.8-1.2
Hardness—Rockwell	D-785-60T	R Scale	92
Thermal			
Melting Point		°F.	346
Deflection Temperature Under Load			
66 PSI	D-648-56	°F.	245
264 PSI	D-648-56	°F.	145
Deformation Under Load 2000 PSI, 122°F., 24 Hrs.	D-621-59	%	3.0
Miscellaneous			
Environmental Stress Cracking	Bell. Labs. Test		None

(1) PLASKON Polypropylenes are available in a range of melt flow rates.

Plaskon Polypropylene is backed by Allied Chemical — one of the world's largest producers of chemicals and plastics. Quality is assured through rigid control procedures . . . satisfaction in molding through Allied's expert technical service team. Listed above are just a few of Plaskon Polypropylene's specifications. For complete performance data and technical information write:

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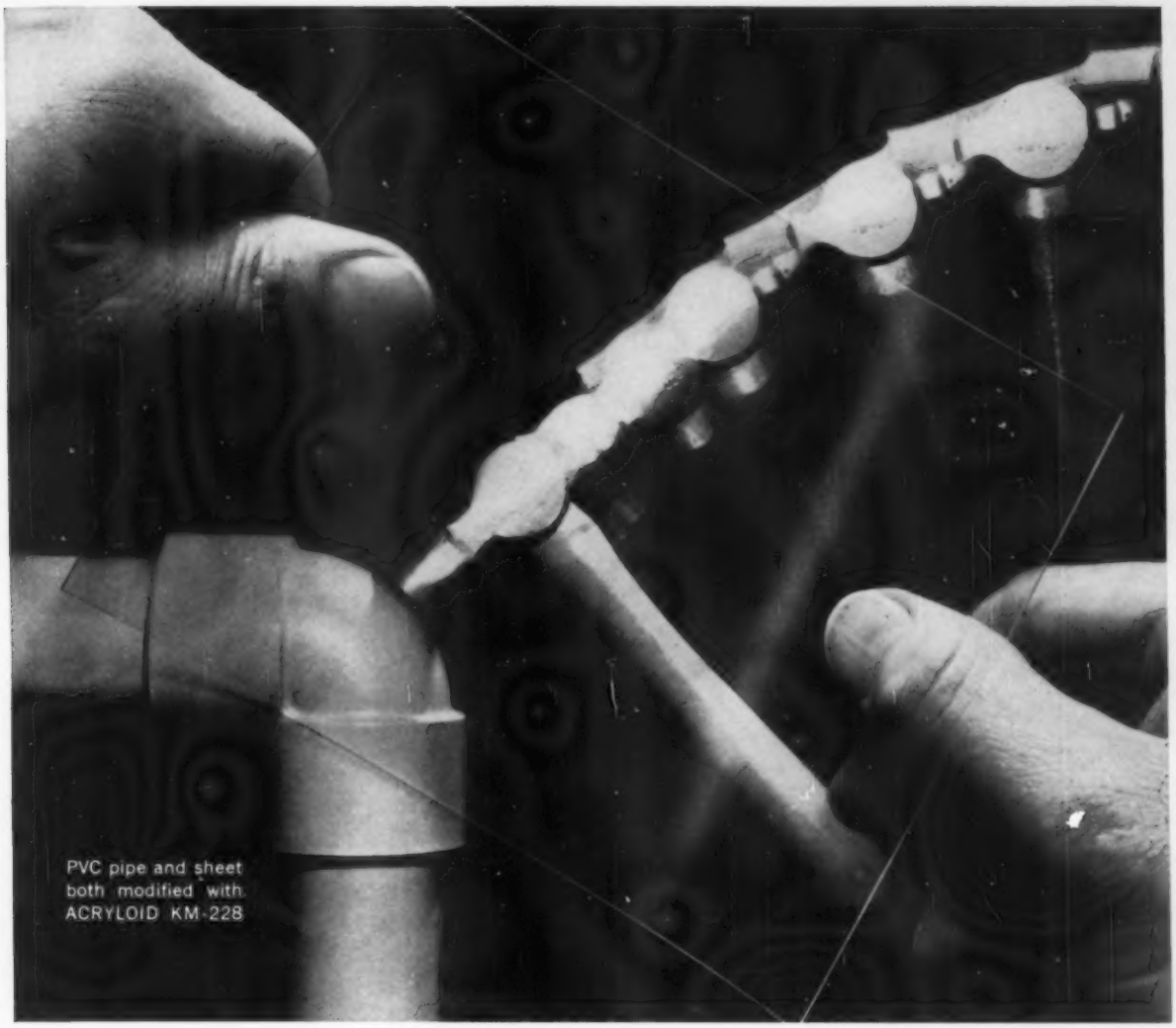

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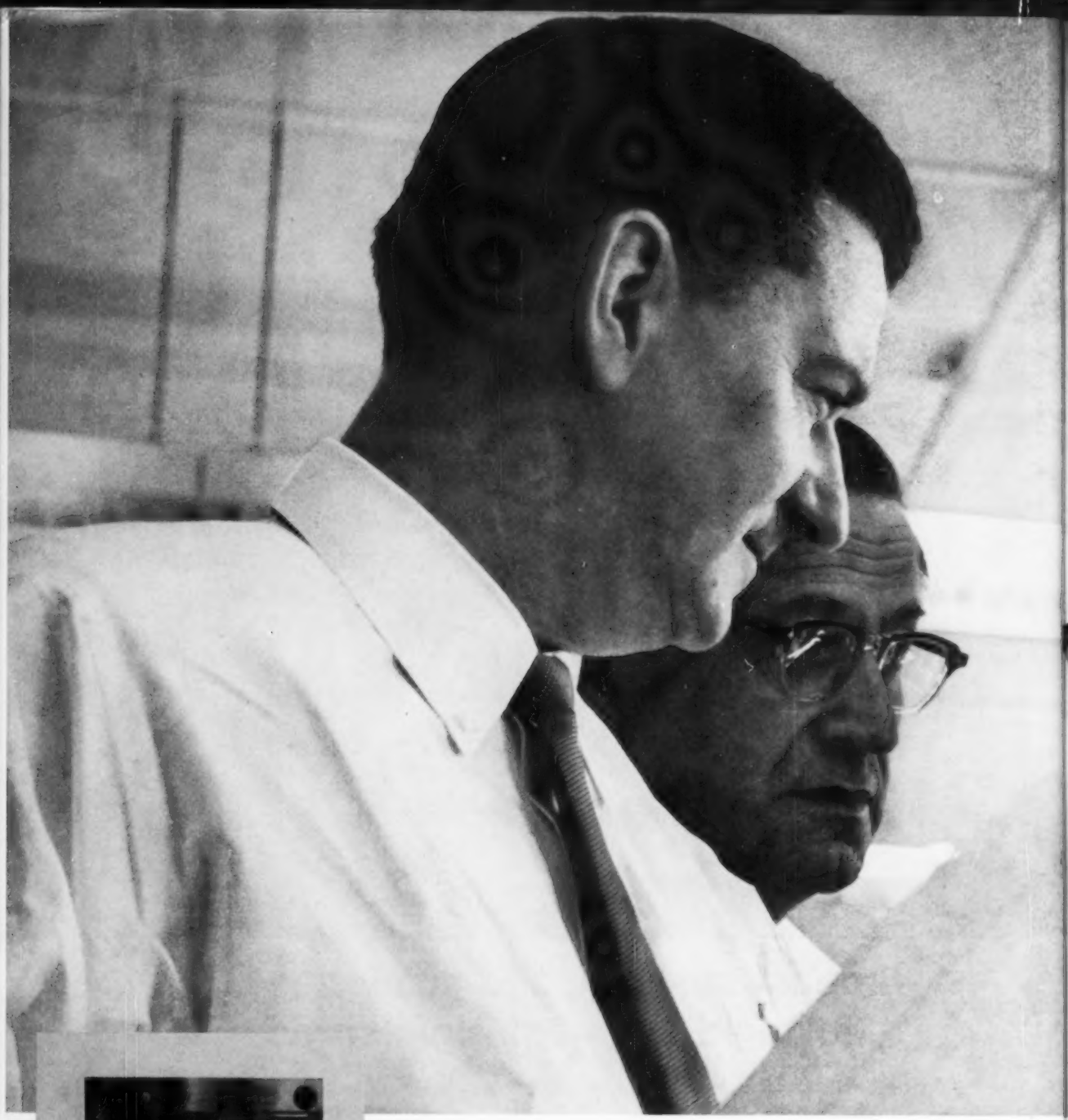

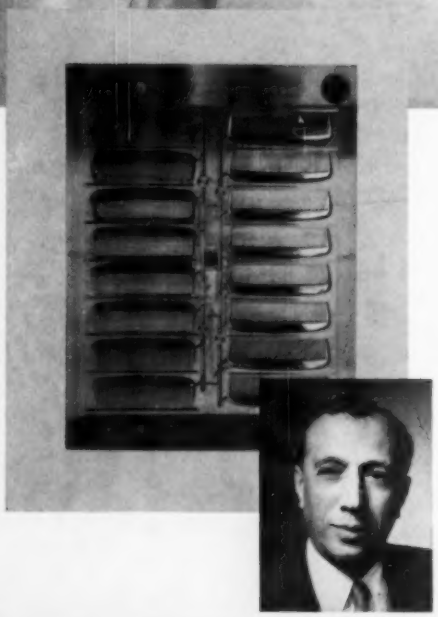

"These men helped solve a customer's mold design problems. Maybe they can solve yours," says Joe Foster.

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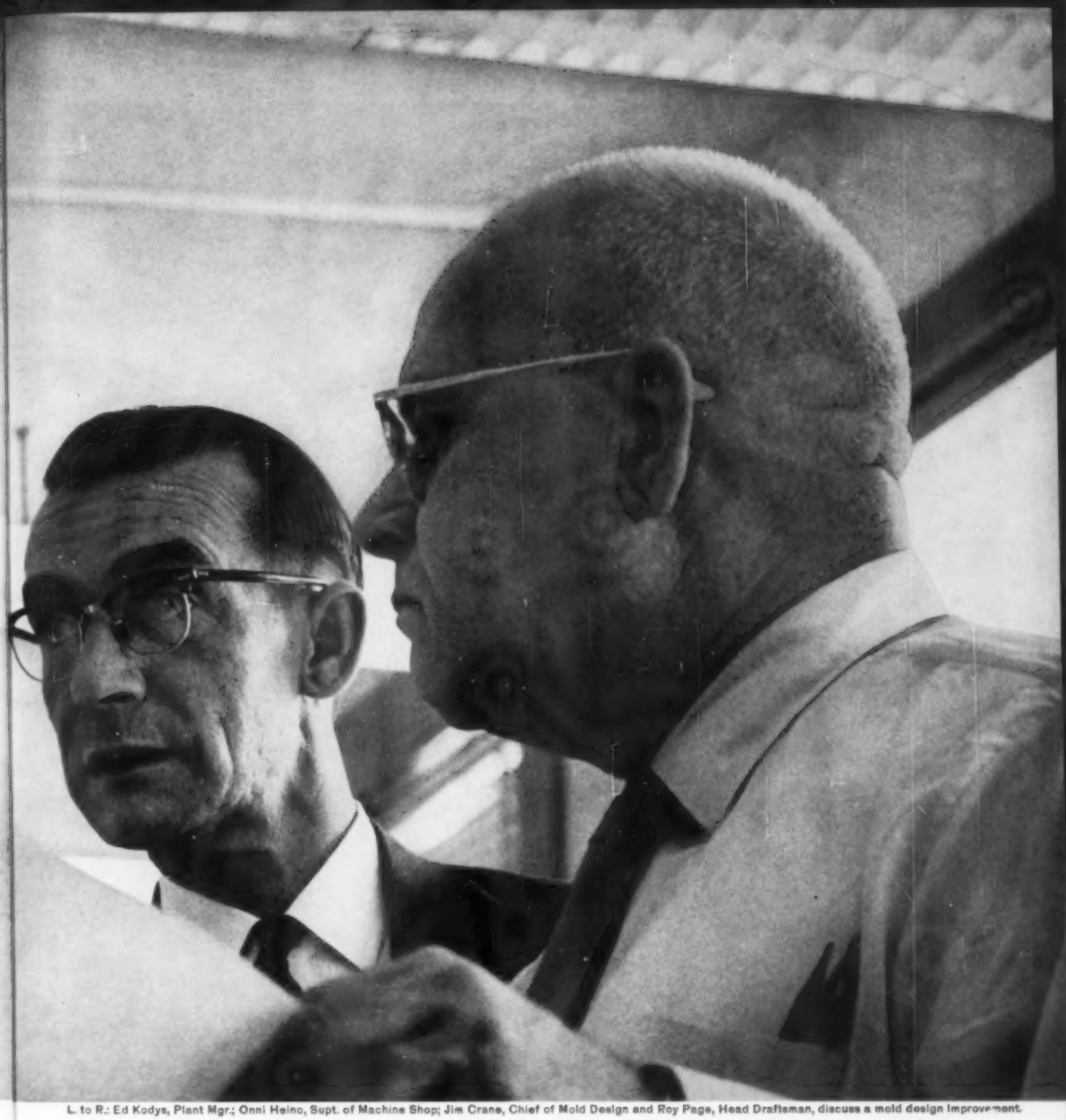

L. to R.: Ed Kodys, Plant Mgr.; Onni Heino, Supt. of Machine Shop; Jim Crane, Chief of Mold Design and Roy Page, Head Draftsman, discuss a mold design improvement.

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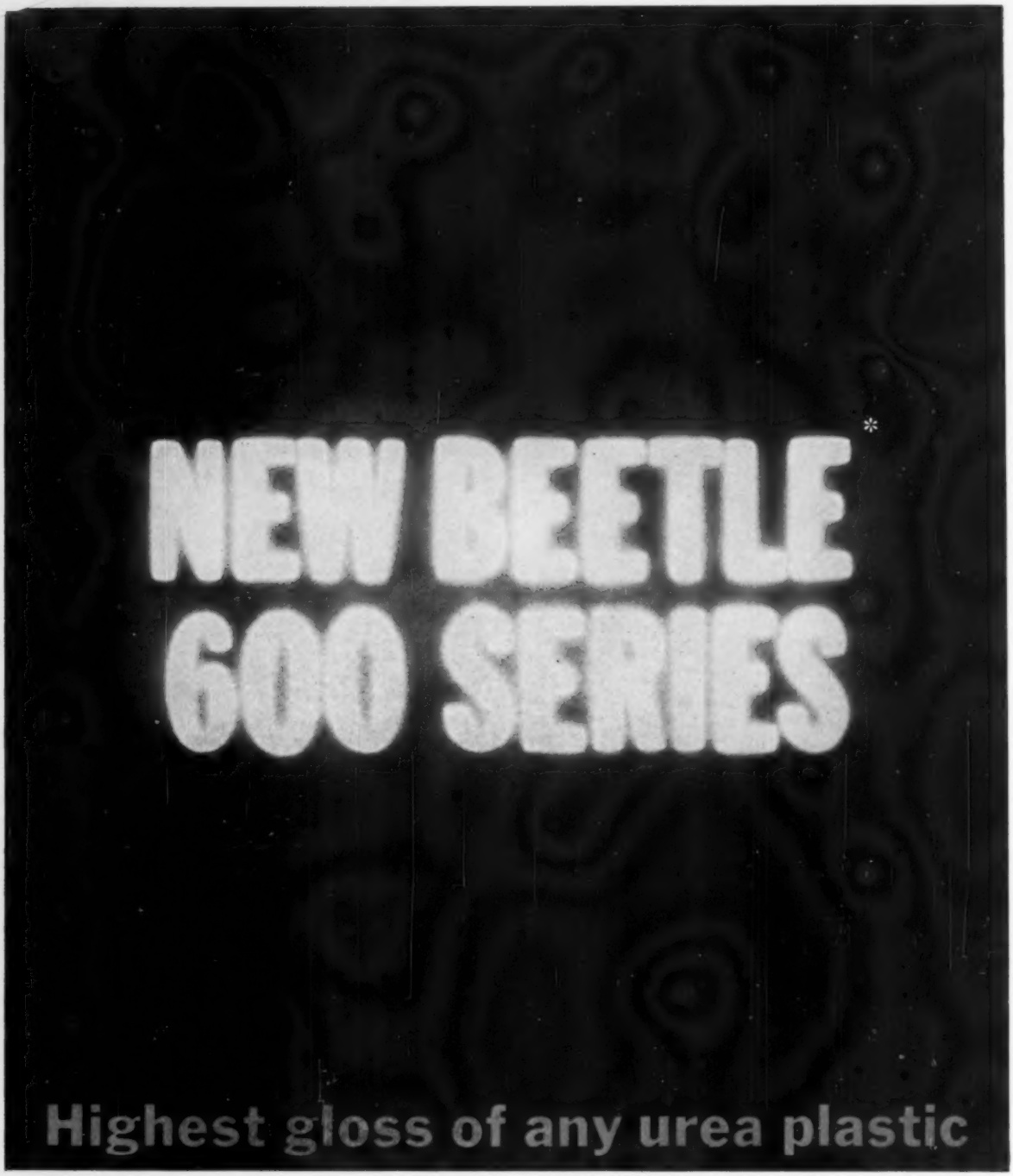

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editorial: Know your costs

The principle of knowing your costs in order to operate profitably is one that every company in the plastics industry, and every other industry also, will immediately state is all-important. Why then does one company fail, a second just get by, and the third prosper—when all three are in the same segment of the industry, make the same type of products of the same type of engineering-wise proficiency, all three companies have equal technical abilities and know-how, and all three have comparable efficiencies in management and personnel. Obviously there must be another, more basic factor to be considered.

Of course, there usually is a quite apparent reason for many business failures. But when all apparent factors appear to be equal, the reason can usually be found in improper accounting and cost analysis procedures. While the first reaction may be that this cannot be, consider it carefully!

Every molder knows of some competitor who copies his own products and then undersells him, eventually causing him to fail. While these copyists also fail sooner or later, it is an almost irresistible temptation to lower the victim-company's prices when bidding and regain the lost business. Unfortunately, however, this cannot always be done without inmmersing yourself also in hot water.

A smart molder doesn't lower his bids promiscously. Instead, he first studies his own costs before leaping into the bid-cutting fray. When he does that, he may find that his own company is not doing as well as anticipated, yet sales volume may be high as ever and production is not faltering. Checking further into the matter, he may find that everything seems fine but profits are lower than they should be. What then? Especially when his accountant assures him that his company's cost figures are satisfactory in all respects. But he still can't reduce his bids, so he can't fight his fire with fire. Is the only recourse available to him to just wait for his competitor to fail?

The above thoughts and those expressed by others from the industry in conversations were brought into sharper focus by the recent arrival in our office of a copy of the Third Edition of the SPI Accounting Manual for the Plastics Industry. Examining this book, it was all too evident that accounting in the plastics industry involves many factors that are essentially peculiar to plastics, and are not common in other industries. With so many cost factors that are not evident, it is apparent why some firms are not doing too well despite all their efforts. Even when other factors are taken into consideration, there are still so many items that can affect costs in plastics, and therefore your company's true position in determining actual costs (hence what it can bid on future items).

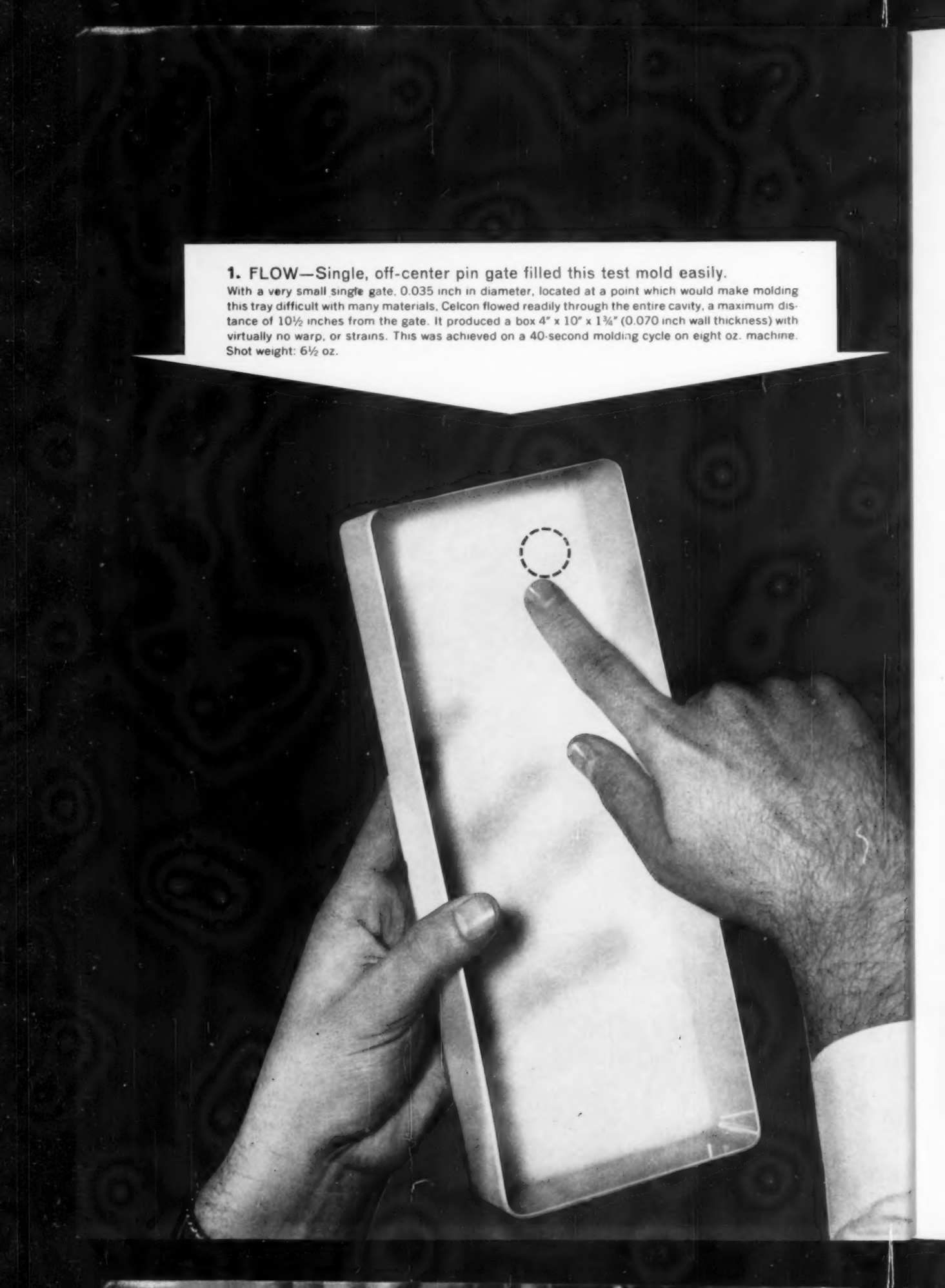
As a case in point, consider machine depreciation rates. An injection machine, for example, operating week after week on a 24-hour, seven-day week cycle depreciates much more rapidly than the same machine operating on a 12-hour, five-day week cycle. Also such continuous operation does not permit full maintenance, since some maintenance operations cannot be done while the machine is running. Then the machine may break down—what of its "standard depreciation rate" then?

Again, we would repeat in all earnestness, know your costs!

Arthur M. Merrill
Special Features Editor

1. FLOW—Single, off-center pin gate filled this test mold easily.

With a very small single gate, 0.035 inch in diameter, located at a point which would make molding this tray difficult with many materials, Celcon flowed readily through the entire cavity, a maximum distance of 10½ inches from the gate. It produced a box 4" x 10" x 1¾" (0.070 inch wall thickness) with virtually no warp, or strains. This was achieved on a 40-second molding cycle on eight oz. machine. Shot weight: 6½ oz.



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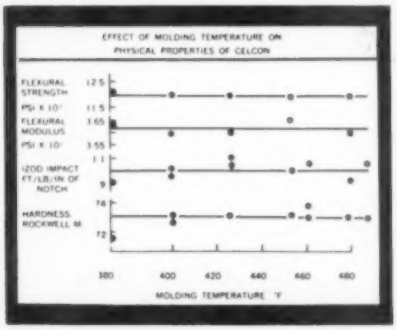
Moldability is only part of the good news about Celcon. There's more, including high-strength, resistance to chemical attack, unusual durability over long periods of time and conditions of use. The coupon will bring you complete details promptly.

2. BROAD MOLDING RANGE—Over 100°F.



Celcon has a broad molding range—over 100°F., during which the stability of the polymer is essentially unaffected. It molds well from 360° to 480°F., although material temperatures of 380° to 420°F. are suggested as usually best from the standpoints of cycling and optimum part properties and appearance.

3. REMOLDING—Celcon regrounds show little change from virgin material.

Comparison of ASTM properties of virgin Celcon with regrounds put through the molding operation five times indicates no significant change in properties. Celcon can be molded and remolded a number of times—thus allowing reuse of scrap on a normal basis.

EFFECT OF REMOLDING ON PROPERTIES CELCON COPOLYMER

		1st MOLDING	5th MOLDING
TENSILE PROPERTIES			
YIELD STRENGTH	PSI	8800	8400
ELONGATION AT YIELD	%	12	12
TENSILE MODULUS	PSI X 10⁵	3.75	3.70
BREAK STRENGTH	PSI	8000	7600
ELONGATION AT BREAK	%	60	60
FLEXURAL STRENGTH, 5%	PSI	12000	12000
FLEXURAL MODULUS	PSI X 10⁵	3.65	3.65
IZOD IMPACT STRENGTH NOTCHED 73°F. 50% RH	FT LB/IN	1.1	1.1
-40°F		1.0	1.0
UNNOTCHED— 73°F. 50% RH	FT LB/IN	20	20
VICAT SOFTENING POINT	C	160	160

Celanese POLYMER COMPANY

A Division of Celanese Corporation of America
Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver
Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 522 Fifth Avenue, N. Y. 36

Celanese®

CELANESE POLYMER COMPANY
Dept. P143-K, 744 Broad Street, Newark 2, N. J.
Please send me technical data on injection molding of Celcon.

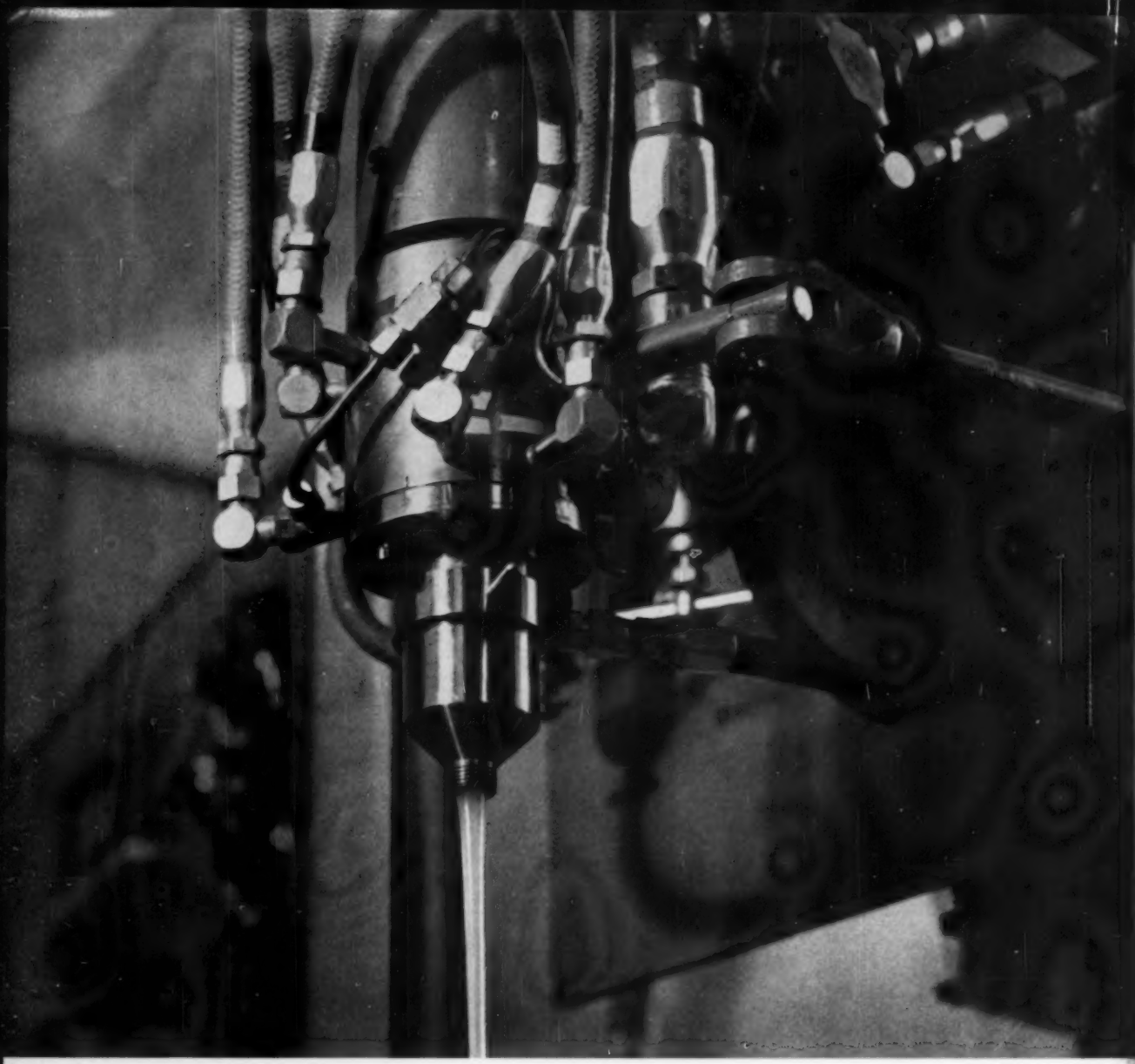
Name_____

Company_____

Address_____

City_____ Zone_____ State_____

For more information check Readers' Service Card No. 117



T-9 is the superior catalyst for U-Foams

More one-shot foam is made with M&T Catalyst T-9 than with any other tin catalyst because it promises and *delivers* high uniform activity essential to proper balance of foaming and polymerization reactions. Catalyst T-9 is the preferred catalyst because its higher stannous content makes it even more economical than stannous octoate—and because it is more uniform, maintaining its activity to give you constant, reproducible U-Foam.

Your inquiries on "tin catalyst" problems are invited. M&T's technical service laboratories include a production-type foaming machine, an example of M&T's pioneering leadership in the development of foam catalysts.

M&T CHEMICALS

M&T PRODUCTS FOR PLASTICS

U-FOAM STANNOUS CATALYSTS
- M&T Catalyst T-9
- M&T Catalyst T-18
- M&T Stannous Octoate
- M&T Stannous Oleate

U-FOAM ORGANOTIN CATALYSTS
- M&T Catalyst T-8
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VINYL STABILIZERS
- Thermolite® Organotin Stabilizers
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- Thermolite® Auxiliary Stabilizers

FLAME RETARDERS
- Thermoguard®-Antimony-Based Flame retarders
- Antimony Oxides
- Antimony Chemicals

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U.S.I. POLYETHYLENE NEWS

A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

NOVEMBER, 1961 — U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation — 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

Laundry-grade polyethylene film is offered along with a choice of two sealing

units and a promotional kit to spur sales. This ultra-clear customized wrap, designed to replace kraft paper, boxes or cellophane, provides such advantages as: fast, foolproof inspection; increased sales appeal; all-weather protection.

CIRCLE ③ ON COUPON

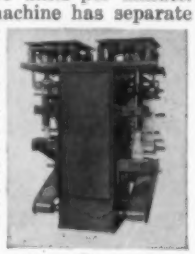
Nuclear thickness gauge using beta radiation is currently available in a new small size. Measuring only 22 inches long and believed to be the simplest of its type, it will indicate or record thicknesses of sheet materials up to 12 inches wide. Unit is described as "relatively inexpensive . . . extremely useful in the laboratory determination of thickness or density of plastic films, paper, coated materials, and metal foils."

CIRCLE ④ ON COUPON

Diet bar, a new baked dietary food product, is packaged in carbon-dioxide atmosphere in a foil-and-polyethylene wrapper. Standard flavors are chocolate, lemon and spice. Three bars daily reportedly provide 1,248 calories.

CIRCLE ⑤ ON COUPON

New "form and fill" machine packages candies and IQF foods in polyethylene at speeds up to 150 units per minute. This double-tube machine has separate drives, permitting either of the two tubes to be operated independently of the other. It produces packages ranging in size from 2" x 3" to 8" x 14½" and handles polyethylene film or polyethylene coated substrates.



CIRCLE ⑥ ON COUPON

Polyethylene Uniquely Qualified For Nuclear Applications

As a Secondary Neutron Shielding Material, It's Unparalleled In Efficiency

There's no dearth of jobs for polyethylene in the nuclear field. It's the lightest of all materials effective against neutrons and, as such, is uniquely suited for use where space and weight are at a premium. In nuclear-powered ships, submarines and yet-to-be-built planes, for example, polyethylene plate is considered the ideal secondary neutron shielding material.

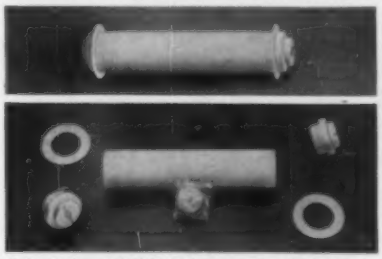
Why It Works

Polyethylene's effectiveness in nuclear operations lies in its ability to slow down the highly penetrating, fast moving, erratic neutrons. The best way to do this, it has been found, is to present a high concentration of light atoms as a barrier to their movement. Since hydrogen is the lightest atom, polyethylene, possessing four hydrogen atoms per monomer unit, has this capacity.

In addition, polyethylene offers: sufficient temperature resistance for most shielding applications; good dimensional stability and form retention; resistance to abrasion and impact; compatibility with other materials. It's also easy and economical to machine. And, it will not give off noxious gases in the event of fire.

Poundage Adds Up

While the number of reactor units is a limiting factor in the market for polyethylene shielding, individual installations do show large-scale use on a poundage basis. For instance, each nuclear submarine built today carries from 55,000 to 60,000 lbs. of polyethylene shielding; the merchant ship N.S. Savannah, 250,000 lbs.; and the guided missile cruiser U.S.S. Long Beach, 500,000 lbs. All of which puts the annual requirement of polyethylene sheet for shielding between 1½ and 2 million pounds!



Polyethylene "rabbit" houses chemicals to be irradiated as part of U.S.I.-sponsored nuclear research. Company's PETROTHENE resins are used to make reactor shielding for atomic powered vessels.

U. S. I. Spurs Use

Reactor shielding is only one way polyethylene participates in nuclear progress. Its applications at the Industrial Reactor Laboratories, Plainsboro, N. J., are typical. This facility is jointly owned by National Distillers and Chemical Corp.'s U.S. Industrial Chemicals Co. division and nine other companies which conduct radiation research related to their particular products.

Here, polyethylene containers known as "rabbits" transport test specimens through pneumatic tubes in and out of specific reactor zones. Polyethylene film protects materials and instruments from radioactive dusts. Polyethylene-coated paper protects floors against contamination. A polyethylene film sleeve encases and protects the mechanical arm of a hot cell manipulator at all times.

CIRCLE ① ON COUPON

Polyethylene Window Posters Fold Down to Envelope Size

Open — it's a colorful 3' x 3' sign ready for posting; closed — it fits into a 10" x 12" envelope. And, because it's of lightweight flexibile polyethylene film, this window display piece can be mailed without stiffener at very low cost. A New Jersey firm designs and produces the small billboards in sizes up to 72" x 72".

CIRCLE ② ON COUPON

WANT MORE INFORMATION

. . . on items mentioned in Polyethylene News? Just circle key no. of developments in which you're interested and mail to U.S.I. Polyethylene News, U.S. Industrial Chemicals Co., 99 Park Avenue, New York 16, N. Y.

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NPL

U.S.I.

Series VI, No. 6

POLYETHYLENE PROCESSING TIPS

ELIMINATING EXCESSIVE BLOCKING IN POLYETHYLENE FILMS AND COATED SUBSTRATES

Blocking – the tendency of a film or coated substrate to adhere to itself or, in some cases, to another surface – plagues many polyethylene extruders and converters. Yet even where blocking is excessive, it can be eliminated in most cases.

Slip and Antiblock Formulations

Primary method for reducing blocking is the incorporation of slip or antiblock formulations in the resin by the polyethylene resin supplier. U.S.I., for example, tailors such additive formulations to various applications and extrusion conditions. These additives are designed to exude to the surface, or "bloom", after extrusion, imparting antiblock characteristics to the film or coating.

To understand how these formulations work, consider what happens when two polyethylene surfaces are in contact. (See Figure 1.) At room temperature, with no pressure on either film, the two films have relatively few areas of actual contact due to their microscopically rough surfaces. However, as temperature or pressure, or both, increase, plastic flow and elastic deformation occur. This increases the area of real contact, causing an increase in the two films' natural attraction for each other – i.e., blocking.

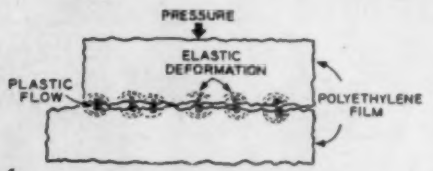

Figure 1.

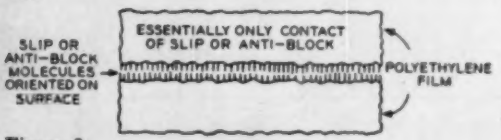

Figure 2.

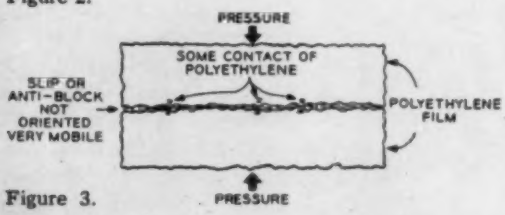

Figure 3.

However, films produced from resins containing slip or antiblock agents have a coating of non-blocking molecules oriented on their surfaces. (See Figure 2.) At room temperature, these molecules virtually eliminate contact between the polyethylene surfaces, giving the film the low blocking characteristics of the additive used. As temperature and pressure rise, the slip or antiblock molecules become very mobile and are no longer oriented, permitting some polyethylene-to-polyethylene contact. (See Figure 3.) Still the area of contact is kept to a minimum by the slip or antiblock agents, and unless relatively high temperature and pressure limits are reached, there should be no blocking problem.

Effect of Film Smoothness and Density

Other film characteristics affecting blocking are film smoothness and density. Very smooth, glossy films have a greater area of contact, and hence, greater blocking tendencies. Higher-density films have harder surfaces and are not so easily deformed. Consequently, they have less tendency to block, all other factors being equal.

Effect of Processing Variables

Processing conditions that produce higher film temperatures or greater pressure on films in contact, will increase blocking. Key processing variables in this respect are extrusion temperature, film cooling, windup tension and, in blown film, nip roll pressure.

Increasing extrusion temperatures may affect blocking two ways: 1. Produce higher film temperatures, and 2. Volatilize the slip or antiblock additives at the extrusion die. Either can cause blocking. Adequate cooling of the film is a countermeasure.

High-tension windup affects blocking by causing pressure on the film roll. The higher the film temperature at windup, naturally, the greater this effect.

Equally important – although applicable only to blown film – is the pressure on the film at the nip rolls. Since these rolls press the blown tube together at a point much closer to the die than the windup unit, they can influence internal blocking of the tube more than windup tension. However, if extrusion temperature is not excessive and cooling is sufficient, no problems should occur at the nip rolls when pressure is held near the minimum necessary to maintain a constant air volume in the "bubble".

Other Factors Affecting Blocking

Film gauge influences blocking too. Thin-gauge films are more susceptible to static electricity buildup and more difficult to separate due to their flimsiness. Any conditions favoring static buildup, of course, add to blocking. Also thinner films run at higher take-off speeds, with hotter windup and higher tension, increases the blocking tendency.

Unfavorable environmental conditions during extrusion or storage can also cause blocking. High room temperature warms the film, while stacking rolls or sheets of film or coated stock creates high pressure. Very low temperatures, on the other hand, may cause film shrinkage and resultant blocking.

When you have excessive blocking, first check your operation to see if modifying extrusion conditions can eliminate it. If blocking cannot be eliminated, consult your resin supplier. U.S.I. technical service engineers are available to help you find and eliminate problem areas.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities

For more information check Readers' Service Card No. 119

Measures Basis Weight and Thickness . . . Only $4985.

BetaMeter in operation measuring 0.00025 film thickness

The Curtiss-Wright Mark II BetaMeter takes the guesswork out of basis weight or thickness measurements in the production of coated stock, paper, plastic or similar sheet products, making it unnecessary to apply "more than enough" to be sure of meeting specifications. In the manufacture of extruded products, close tolerances are maintained to ensure correct length yield per pound.

This economical BetaMeter utilizes radioactive isotopes to measure actual production quality without contacting the material or affecting the process in any way. Weight or thickness variations across the sheet are detected instantly, enabling the operator to make immediate corrective adjustments. The Result: Faster start-ups and grade changes, reduced scrap losses and more uniform quality products.

The $4985 price includes control console, recorder, and BetaMeter on "C" frame for handling up to 36" webs. Other frames for larger webs are available at reasonable cost. Automatic process control equipment is manufactured for the BetaMeter and all other standard Curtiss-Wright measuring systems.

Increase your profits through better quality control with the economically-priced Curtiss-Wright BetaMeter - phone SWinburne 9-0500 or write.

Princeton Division CURTISS WRIGHT CORPORATION Princeton, New Jersey

IN CANADA: Canadian Curtiss-Wright Ltd., Industrial Process Controls, Davis Road, Oakville, Ontario.

For more information check Readers' Service Card No. 119

"By selecting from the most complete styrene line we slashed shipping breakage 95% ...cut start-up time 50%"

"Only Monsanto was able to supply the two styrene materials we needed for both overseas and domestic use," reports Mr. Robert B. Thomson, Purchasing Agent at Jet Spray Cooler, Inc., Waltham, Massachusetts. "For domestic requirements, we switched to *Lustrex* for the side panel on our cooler, cutting start-up time 50% and getting the right level of performance with economical cost. For overseas use, we switched to *Lustran*, cutting shipping breakage to less than 1%. Both Lustran and Lustrex work smoothly and completely in the same mold. Components, with dimension and color perfectly matched, are used interchangeably.

Can the broadest line of styrene materials with the widest range of mechanical properties provide a closer match to the price/performance requirements of your applications? By selecting from the only complete line of general purpose, medium impact, high impact, super high impact, SAN or SAB materials you don't have to over-buy or under-engineer. You get the impartial material recommendations that only a supplier with a full line can offer. In addition, you can make savings by combining shipments.

Ask your Monsanto representative to show you how the Lustrex-Lustran line of styrene materials can help you engineer better products at lower costs.

LUSTREX®
Styrene

LUSTRAN®
Styrene acrylonitrile
Styrene acrylonitrile butadiene

Monsanto

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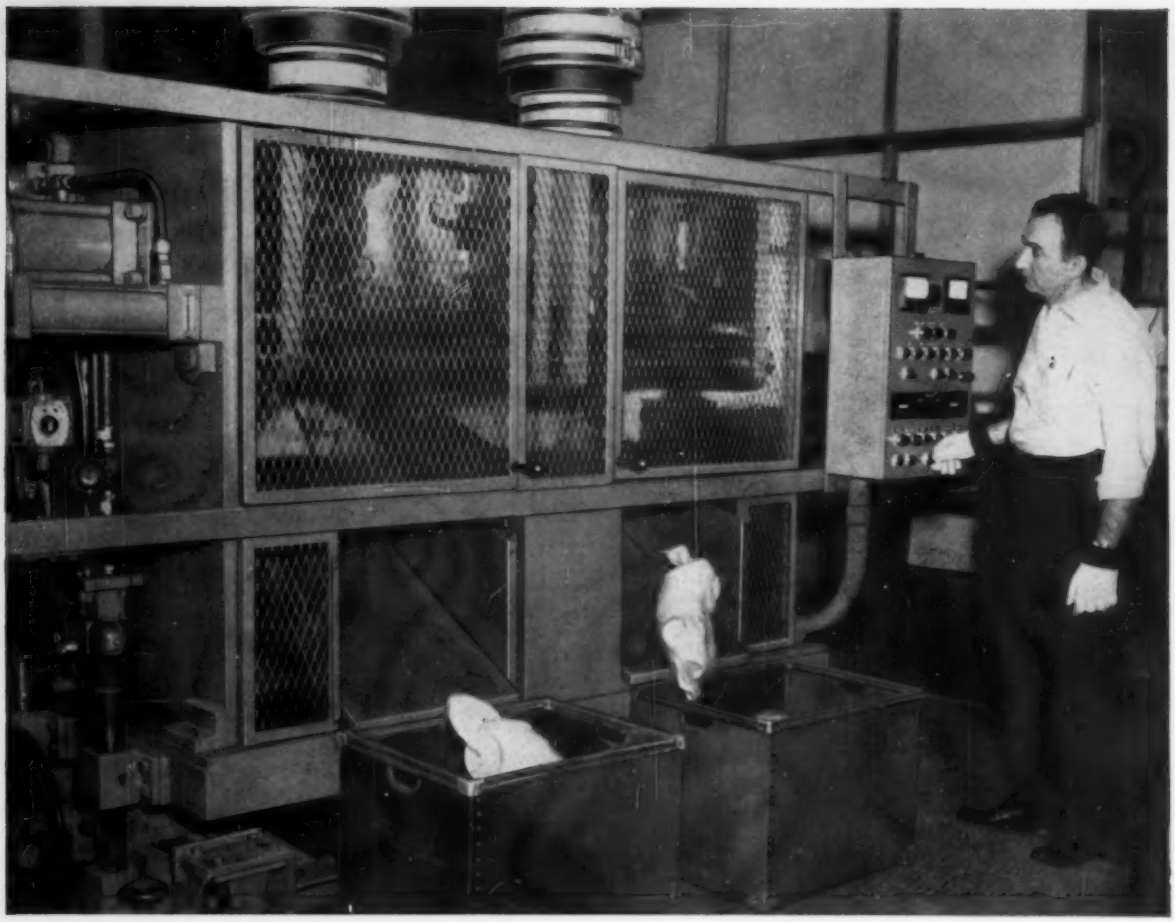
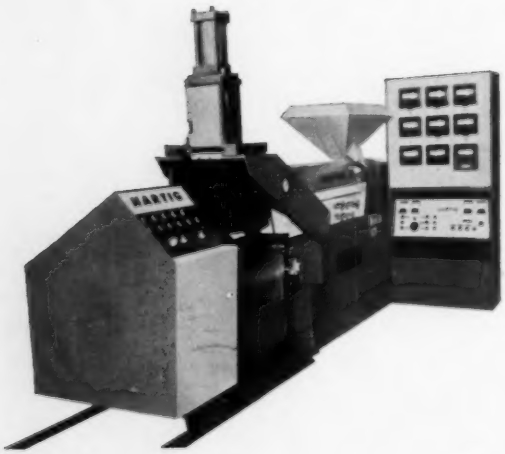


New Hartig blow molding press



in action at Ideal Toy. Shown above is one of the new Hartig blow molding machines producing doll bodies. Operation is continuous and automatic; output is of high quality and uniform; maintenance is simple. This press can handle parts up to 17-inch diameter, is track-mounted for easy mold changes and extruder maintenance.

The Hartig extruder with ram/accumulator provides optimum parison uniformity and shot size.

You are invited to use the experimental blow molding machine in the Hartig laboratory shown at left for experimental production of your parts. Write for specifications.

HARTIG

technical competence in plastics process machinery

WALDRON-HARTIG, Box 531, Westfield, N. J. / a division of Midland-Ross Corporation MR

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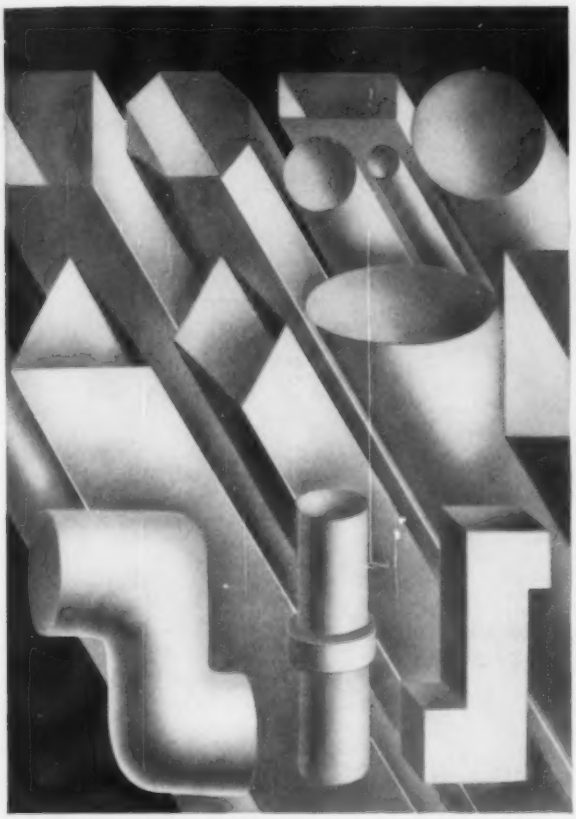

HERE'S HIGH STAYING POWER AT LOW COST FOR STRUCTURALS... OR SYMPHONIES!

Whether you make PVC rigids for structural purposes—or hi-fi records for quality stereo—you can impart exceptional staying power to your formulations by using National Lead's basic lead stabilizers—and do it economically too. Choose from four high-performance stabilizers—DYPHOS®, LECTRO® 78, TRIBASE® and DS-207®.

Superior strength and outstanding weathering can be built into pipe and other structural shapes—at low stabilizer cost. The best possible tensile, impact and rupture resistance can be achieved with these lead stabilizers.

Best stabilizer combination for records is LECTRO 78 and DS-207. Working together, these provide the high heat stability required for processing and subsequent recycling. They help assure low noise levels for the entire score . . . maintaining these levels after many plays. In monaural and stereo records, this combination assures outstanding wear resistance and surface properties.

- DYPHOS—Highest heat stability of all four. Best stabilizer for weather resistance.
- LECTRO 78 – Performance almost comparable to DYPHOS . . . at lower processing costs.
- TRIBASE—Most economical primary stabilizer.
- DS-207—Lubricating stabilizer recommended for co-use with each of the others.

For a complete listing and description of these products, see Pages 471 through 482 of the 1961 Chemical Materials Catalog. And for additional helpful information, fill in and mail the coupon below.

BASIC LEAD STABILIZERS... Chemical Developments of

National Lead Company

General Offices: **111 Broadway, New York 6, N.Y.**

KC-9902B

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National Lead Company, General Offices: 111 Broadway, New York 6, N. Y. In Canada: Canadian Titanium Pigments Limited, 1401 McGill College Avenue, Montreal, Que.

Gentlemen: Please send brochures on DYPHOS, LECTRO 78, TRIBASE and DS-207 basic lead stabilizers.

Name_____ Title_____

Firm_____

Address_____

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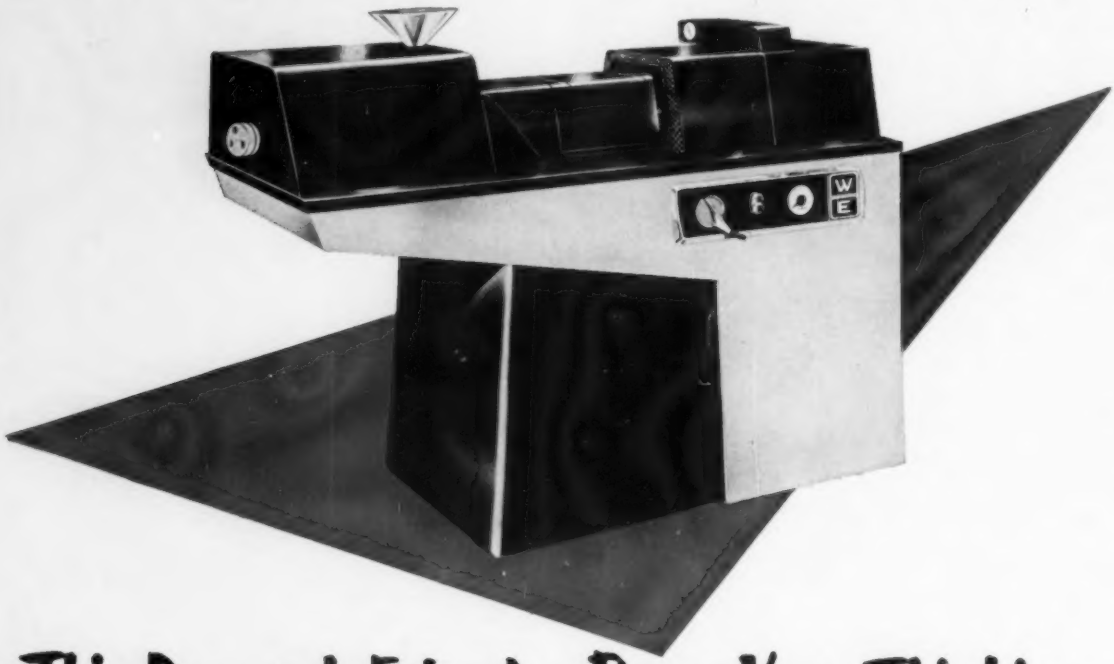
A NEW TOOL FOR SCIENCE AND THE DEVELOPMENT OF RESEARCH POLYMERS



This Research Extruder Bases Your Thinking for the Future on Practical Results

TODAY

Here are a few of the operations possible because of the unusual versatility of Welding Engineers dual worm continuous operation. 8-inch laboratory extruder: Compounding, Devolatilizing, Extruding, Continuous Polymerization, Sampling, etc. New materials in new methods of manipulation. Abilities as extensive as the scientific imagination of the research mind in the field of new polymers. Send for catalog No. 112.

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PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

GILBERT J. DARCY*

Molding vinyl footwear

In 10 short years plastics have made tremendous inroads in the shoe industry. While Mr. Darcy is concerned primarily with slush molding techniques, he also points out the technique for low-pressure injection molding and for installing nylon inserts and silicone spray coating. He was the first to adhere PVC soles and heels to shoe uppers in a commercial operation.—Editor.

Probably the earliest use of vinyl in footwear involved the heat sealing of transparent vinyl film to protect women's shoes in rainy weather. Quality was poor; however, this attempt led almost directly to dip molding. Here, a metal last was preheated and dipped into vinyl plastisol. A coating or skin gelled around the last, which was removed, drained, fused with heat, and stripped. Again, quality was poor.

In 1950, Sidney Porter of Brampton, Ontario, was issued patents on selective heating, pertaining to slush molding. He granted manufacturing rights to major rubber companies in the United States and Canada, and has promoted slush molding of vinyl footwear throughout the world. The process involves preheating a hollow electroformed copper mold which has the desired shape and design on the inside. The mold is filled with vinyl plastisol and, after a predetermined period, the excess is poured off leaving the desired thickness of plastisol gel adhering to the mold contours. After further cure, the shoe can be stripped from the mold.

To date, all machinery has been made by the footwear manufacturer; consequently there are variations from one factory to another. The process is completely conveyorized, and requires close control of temperatures, cycles, plastisol formulation, and mixing to provide uniform products.

The usual vinyl footwear factory includes the following components: mixing room; conveyor area; combination trimming, finishing, and packaging room; model making and electroforming room; and laboratory. A typical production line consists of an oblong continuous chain conveyor about 56 feet long by 5 feet wide mounted on 5-foot high posts (See Fig. 1). Four infrared ovens are located at specific points through which the conveyor travels, plus a bank of cooling fans, a cold water spray, and a unit for spraying silicone resin. The plastisol storage tank is equipped with a deaeration unit for removing entrapped air and a quick opening valve for the gravity filling of molds. These molds are hung onto the conveyor by means of hooks.

Slush molding process

Molds are filled with vinyl plastisol to within ½-inch of the top, and placed on the conveyor at the entrance to Oven #1. Travel time through this 14-foot oven is 2 minutes, 10 seconds, during which time a skin or film is gelled to the mold interior. On emerging from the oven, the excess plastisol is dumped into a material pan and returned by vacuum to the storage tank. The mold is hung on the conveyor in an inverted position, draining for a distance of 16½ feet which it raverses in 2 minutes, 25 seconds. It then passes through Oven #2 where its outer skin is gelled. At this point the mold is filled with a specially formulated plastisol having good slip characteristics—mold heat is adequate to gel this second coat.

The mold is again dumped and drained for a distance of 5 feet, 10 inches which is traverses in 40 seconds. Passing through Oven #3 gels this final skin. On re-

Assorted slush-molded footwear.

* Dir. Rsch. & Dev., Holeproof Hosiery Co., formerly of Kaufman Rubber, Ltd.

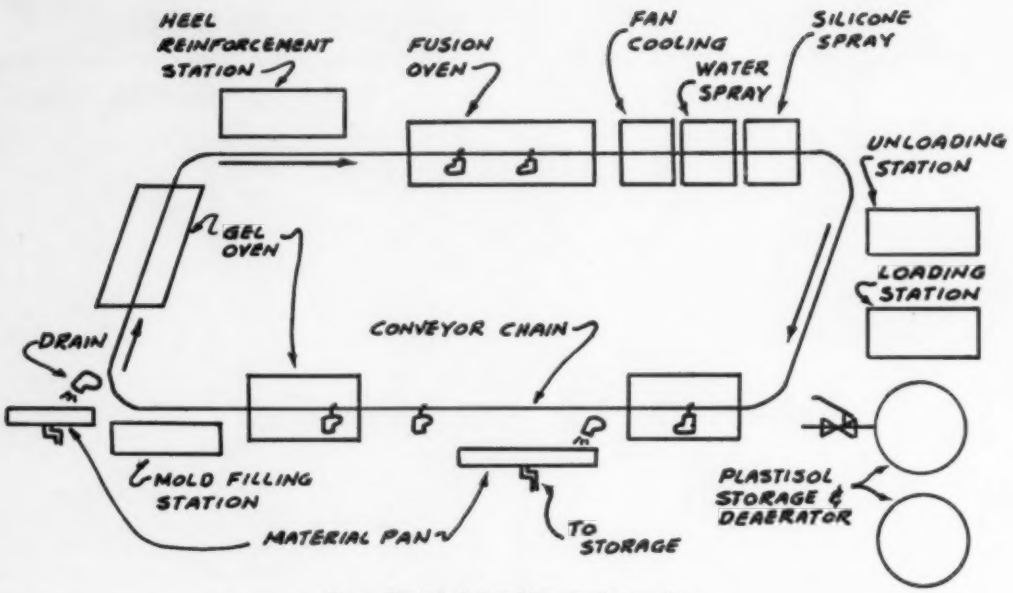
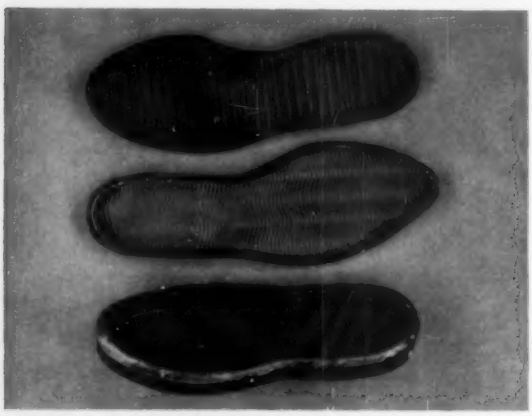


Fig. 1. Typical slush-molding production line.

moval, a nylon reinforcement is stuck in the heel. This insert has a slightly smaller circumference than the heel, and is die cut from open-weave nylon fabric. It is covered with plastisol and fused in place, with the mold passing upright through Oven #4. This oven is 37 feet long and is heated to 375° F. Passage takes about 9 minutes.

The mold is first cooled by passing over a fan, then by a spray of cold water. The following stage is passage through a spray cabinet where the interior is automatically sprayed with silicone to improve slip characteristics. When the mold reaches the unloading station, it is removed, the top is trimmed with a knife, and the skin pulled from the mold by hand. The shoe has a cuff approximately 2 inches longer than the top bind.

The empty mold is again filled, placed on the conveyor, and the cycle is resumed. A new mold is filled every 14 seconds, and spacing is one foot apart. A conveyor of this type requires 56 pairs of molds for full production, and a pair of shoes is obtained every 28 seconds. The finished shoe goes to a trimming belt where the excess is trimmed by various means such as die cutting, scissors, and hot wire.



Electroformed molds.

Plastisol mixing

Equipment is inexpensive and labor costs are low. A typical mixing room consists of a plasticizer storage tank, a mixing tank equipped with a 3-hp. propeller-type mixer, a de-aerator, resin storage, and plastisol storage tank. For good de-aeration, a long cylindrical tank is fitted with baffles over which the plastisol flows in a thin film. A vacuum applied to this tank will draw plastisol into the top of the de-aerator and over the baffles. Most of the entrained air will be removed during this flow over the baffles at reduced pressures.

Plasticizer is measured into a mixing tank. Solid com-

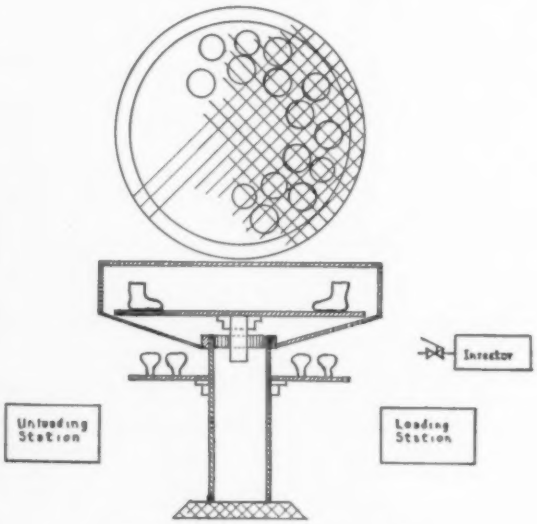
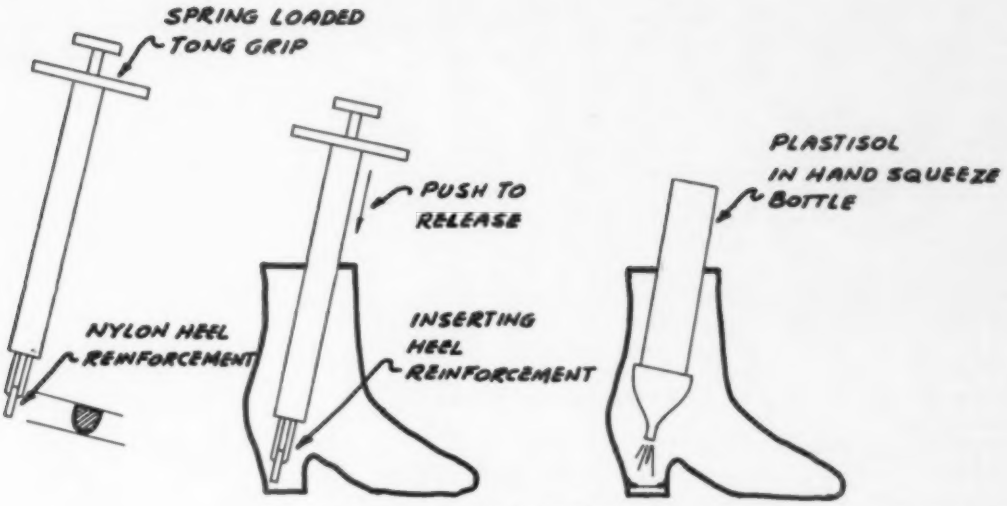


Fig. 2. Low-pressure injection molding.



Three steps in nylon heel reinforcement.

ponents such as resin, filler, stabilizer, and pigment are manually weighed up and added directly to the plasticizer. After sufficient agitation (15 minutes), the mix is de-aerated, the vacuum line is opened, and the plastisol drawn from the mix tank to the de-aerator from which it is gravity fed to a plastisol storage tank.

Low-pressure injection molding

A mold comprising sole and foxing is electroformed with the circumference at the top of the foxing slightly larger than that of the last, which is lasted with an upper, placed in the mold, and locked with a quick-closing clamp. This upper forms a seal between the last and the mold. The back of the mold has a 3/16-inch hole through which the cavity is filled. A low-pressure (20 psi.) injector fills the cavity in approximately 8 seconds. A small toggle clamp mounted on the side of the mold is closed when the mold is removed from the injector unit to prevent bleeding. The shoes are cured in a rotary oven over a bank of infrared lamps.

A typical production oven consists of a rotating wire

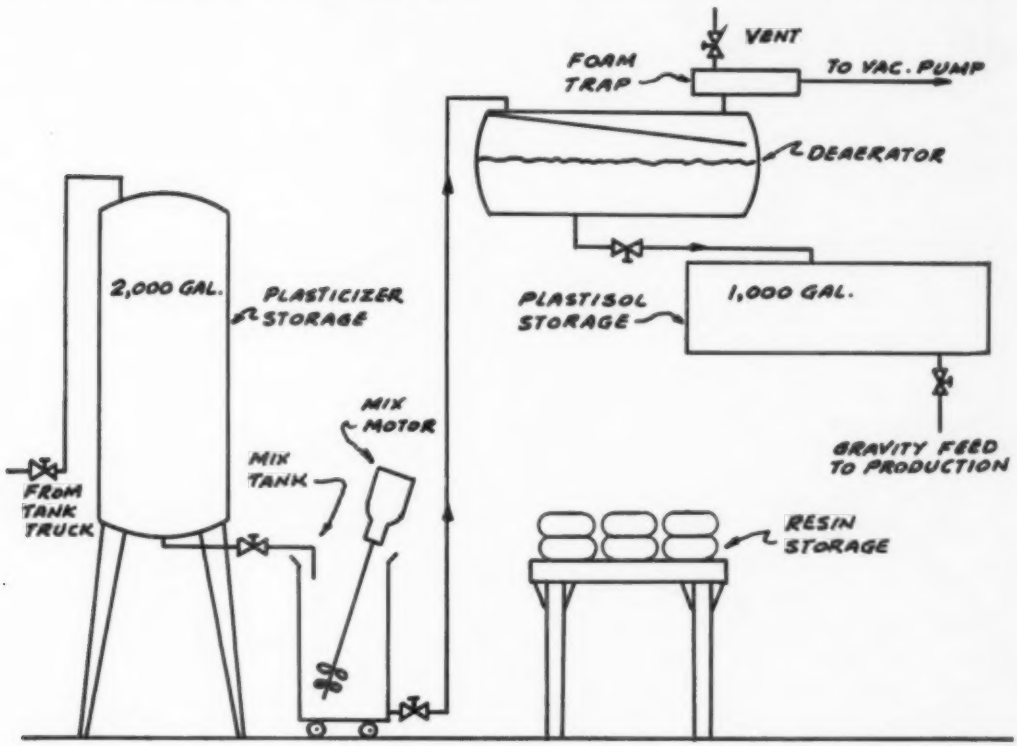


Fig. 3. Plastisol mixing set-up.

mesh shelf 48 inches in diameter mounted over two circular banks of infrared lamps, 10 in one bank and 15 in the other. An aluminum hood covers the unit, and has an opening at the bottom and a front entrance. The oven is loaded with 10 pairs of molds. One pair of molds are removed from the oven every minute, simultaneously replacing them with another pair. Cure, therefore, is 10 minutes.

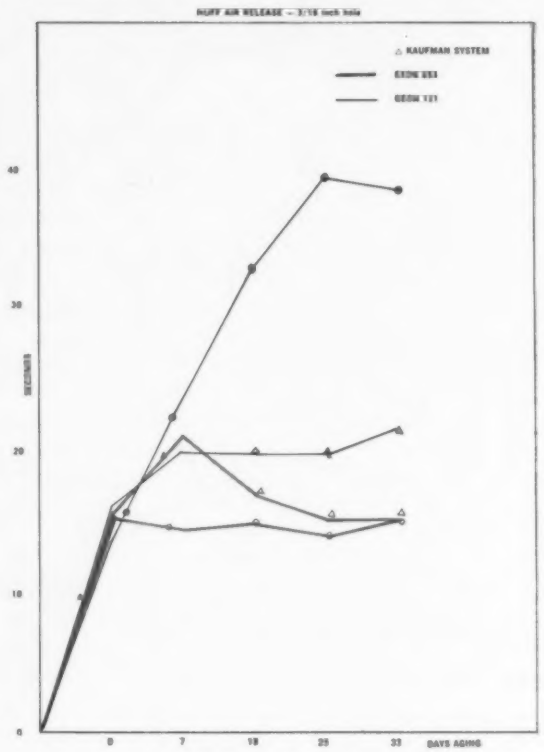
A last is lasted with a sock lasted upper, placed in the mold, and locked. This is placed against the injector with the nozzle in the mold. The valve is depressed by the operator's foot, the unit is removed, the toggle clamp is closed, and the unit is placed in the rotary oven. A second operator removes molds from the oven, opens the clamps, and delasts and strips the shoes. For larger production, the slush molding conveyor is utilized using the fusion oven only.

In original development work, standard plastisols were used which fuse at 350° F., the time being relative to the thickness. Under these conditions, the uppers discolored and tenderized. A low-temperature fast-fusion plastisol was developed which fused at 265° F., the time again depending on the thickness. This overcame the early defects.

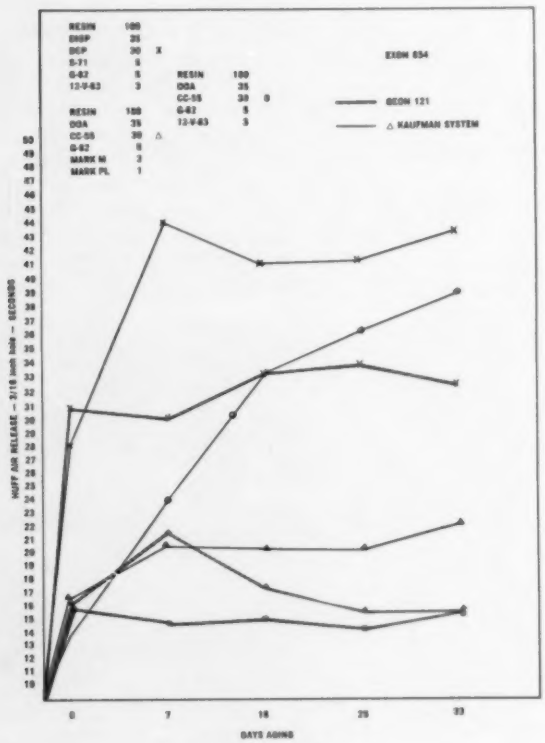
Model making

A wooden last of the actual size and shape of a shoe is purchased from a last manufacturer. A rubber skin is layed up on this last and cured using conventional techniques. Skin thickness is built up to allow for shrinkage, after which it is stripped from the last and sprayed

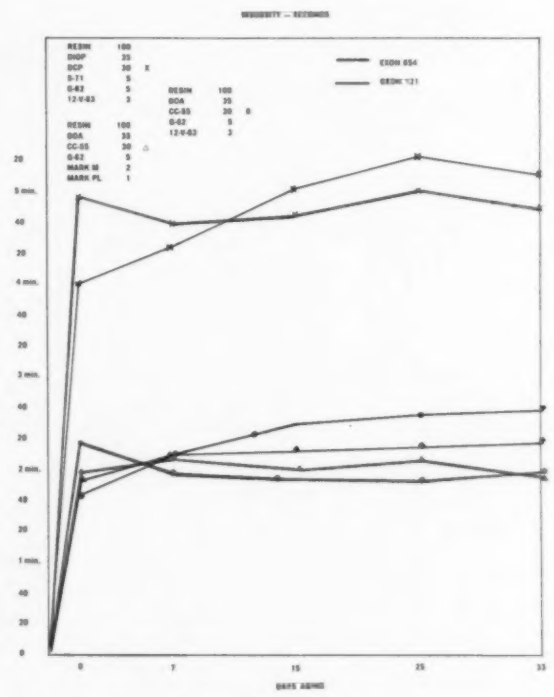
(Continued on page 52)



Viscosity-Huff Air Release.



Viscosity-Huff Air Release.



Viscosity-Ford Cup.

R. E. JONES*

Rigid urethane foam— process variables and test procedures

Although this article deals mainly with a specific material designed for low-temperature pour-in-place insulation, it is the most comprehensive work we have seen to date on the processing techniques involved in making urethane foam insulation. Testing procedures seem equally important. The conclusion of a two part article.—Editor

Density distribution in panels

The problem of skin densification is especially important at the low density levels required for thermal insulation. This section therefore, deals primarily with foam densities in the range of 2 lb/ft^3. As a base point the control cup density test is used.

In discussing the factors that affect density distribution in panels, it is assumed that the control cup density and specific gravity have been obtained. Factors that influence control density, such as fluorocarbon content and component temperatures, will affect panel densities in the same direction and same order of magnitude as control densities. Panel density terms are shown in Fig. 9.

In a fluorocarbon-blown foam, the cellular structure is obtained by the heating and volatilization of the fluorocarbon liquid contained in the mixed components. Any condition that restricts the temperature of the foaming systems (e.g. the mold) or tends to increase back pressure (e.g. packing, narrow cross section, high rise) will limit the expansion of the fluorocarbon and naturally increase the density. These conditions give rise to density gradients in panels and other molded parts.

Temperature factors

CATALYST CONCENTRATION in the foam system profoundly affects handling time, rise time, and time to maximum exothermic temperature. In doubling the catalyst content, the handling time and rise times are decreased by about 50%. In addition, increased catalyst content improves density distribution and increases foaming pressure. The result is that the recommended catalyst concentration is the highest which will provide sufficient handling time for dispensing, plus sufficient rise time for closing the mold.

COMPONENT TEMPERATURES greatly affect the handling time and, to a lesser degree, the rise time. A decrease in component temperature of 10°F., causes a 40% increase in handling time, although only a 20% increase in rise time. Because of the marked effect on handling time, component temperature may be used to extend handling time without altering the catalyst concentration.

In addition, lowering the average component temperature increases the time to maximum exothermic temperature, worsens density distribution, increases mold pressures, and results in a more viscous flow of foam. Although none of these effects are prohibitive in the range 60-90°F., an average component temperature of 75° F., is recommended.

MOLD TEMPERATURE AND DENSITY PROFILE. The effect of mold surface temperature on density distribution can be illustrated in several ways. Fig. 10 is a density profile at several temperatures showing that a ½-inch trim removes virtually all density gradients. Density distribution becomes more uniform as the mold temperature increases the optimum being in the range of 140-160° F.

Up to a certain point, the maximum temperature reached at any point in a foaming sysem greatly affects the density in that area. Fig. 10 showed that starting at a half inch from a mold surface at 80°F., the density no longer changes significantly. Temperature measurements under somewhat similar conditions indicate that the maximum temperature reached at a half inch is

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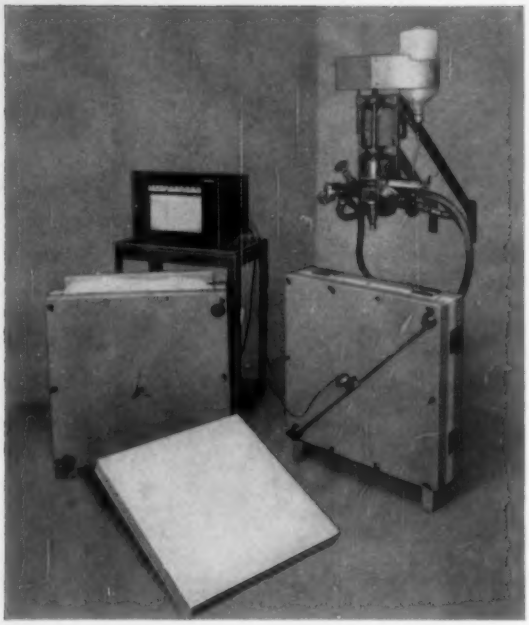


Fig. 8. Excess foam appears at the top of the unrestrained mold on the left. The restrained mold on the right, connected to temperature-measuring device and dial gage, is ready to receive a charge from the metering machine. Finished foam panel is displayed in foreground.

about 160-180°F., although the center temperature may reach 245°F. Temperature is therefore solely responsible for density gradients since it is the only variable, chemical or physical, in the foam.

Thus we may draw two conclusions: The final temperature of the foam at any point up to some limiting temperature in the range of 160°F., profoundly affects density at that point. Second, a trim of ½-inch at any mold surface should be sufficient to eliminate most density gradients due to temperature effects. This assumes normal reaction rates equivalent to a rise time of about 6 minutes or less. For large pours, a trim of 1 inch is normally taken to obtain "core" properties.

In a foaming system, heat is given off as the density decreases. Under these dynamic conditions the temperature at any point depends on the rate at which heat is generated and the rate at which it is dissipated. The rate of heat loss depends on the insulating value of the foam and the temperature of the mold surface. Thus, the faster the rise time, the less time for heat loss, and this decreases the overall density. The overall density improves since the density decrease is much sharper from the skin to the core. Higher catalyst concentration can improve the overall density in a similar manner since it also reduces the rise time.

Mold Temperature and Density Areas. Fig. 10 in the last section showed how density varies across a panel, and how this density profile varies from one mold temperature to another. Fig. 11 breaks the profile into density areas for a vertical pour.

"In a "vertical" pour the foam rises parallel to the facings, while in a "horizontal" pour the foam rise direction is perpendicular to the facings. Fig. 11 shows that the core density remains relatively constant with changes in temperature, while the skin, and skin-to-skin densities decrease rapidly with the higher mold temperatures. Mold temperature would therefore be extremely effective in regulating the overall density of thin panels, since the skin would be a major part of the cross section. In the case of the horizontal pour, the overall skin densities are less than for a vertical pour. The horizontal pour also results in differences between the top skin and bottom skin.

For all of these pours, the minimum mold surface temperature required for good skin-to-skin density distribution can be taken as approximately 130°F. When mold surfaces are used above 100°F., the panel core densities are only slightly higher than that of the control cup core density in a 24″ x 24″ x 2″ thick panel, provided that compensation for packing is made.

Fig. 12 covers the effect of panel thickness and mold surface temperature on overall vertical panel density. Since the density gradient is most sharp in the outer half inch skin, one would expect the overall density to be less with the wider panels.

Mold Material affects the final mold surface temperature. Molds constructed of metal or other materials which dissipate heat rapidly will increase the skin density and the mold cycle time. Molds constructed of an insulating material such as plywood will retain the heat of reaction. This reduces the mold cycle time and provides a more uniform density gradient from the skin to the core. The effect of different mold materials can be counteracted by preheating the mold.

The change in surface temperature for several mold materials is given in Table 3. The change is largely independent of the starting temperature.

Pressure factors

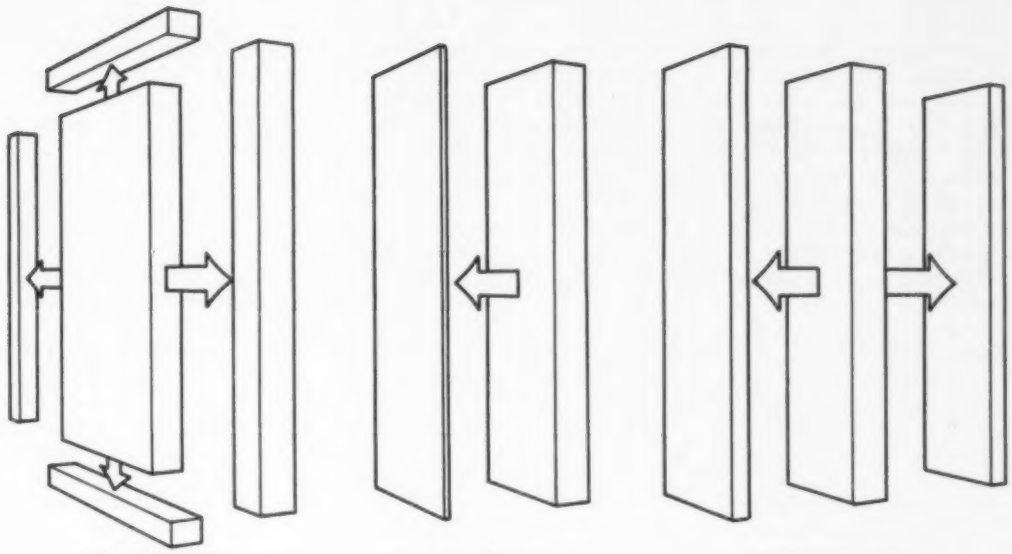
Direction of Pour (Laydown). In addition to density gradients at the mold surface, there may be a density

Table 3

SUMMARY OF CHANGES IN MOLD SURFACE TEMPERATURE FOR VARIOUS MOLD MATERIALS FOR THE H-602 SYSTEM

Mold Backing	Mold Facing*	Foam Core Density, lb/ft³	Panel Thick, In.	Approximate Mold Surface ΔT, ° F
½ in. aluminum	—	1.8	2	3
¾ in. plywood	—	1.8	2	15
4 lb/ft³ foam (1 in.)	0.032 Al.	1.8	2	40
4 lb/ft³ foam (1 in.)	—	1.8	2	75

*A 0.001 inch aluminum foil was used as a mold release on all mold surfaces.



SKIN TO SKIN DENSITY
(at least one inch trimmed from four sides).

SKIN DENSITY
(0.1 inch skin taken from skin to skin density specimen).

PANEL CORE DENSITY
(0.5 inch skin taken from skin to skin density specimen).

Fig. 9. Panel density terms.

variation in planes parallel to the facing surface. This condition depends on the method of pouring—horizontal or vertical. The choice of pour usually depends on the shape of the part and the mixing and dispensing facilities. For flat panel production, a horizontal pour offers the greatest potential in density distribution and physical properties. For intricate parts, a vertical pour is often used.

Under optimum foaming conditions in a horizontal pour, the density variation in planes parallel to the facing can be virtually eliminated. The situation is much the same with vertical pours up to 24-inch rises and thicknesses of 2 inches or greater. However, for higher rises the vertical pour density, distribution is much worse. There is a tendency for the center to be more dense, and the top of the pour to be less dense than the bottom.

Although horizontal pours with their minimum rise height are preferred, they require mechanization to work

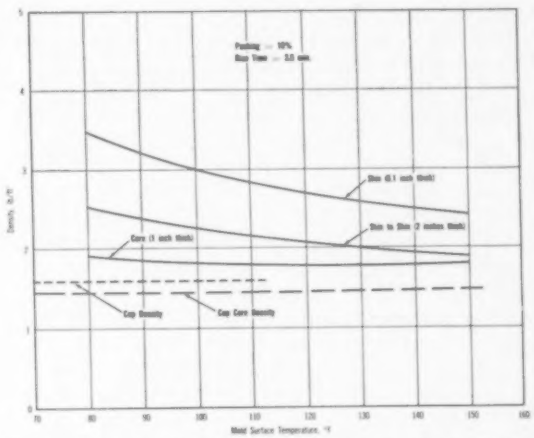


Fig. 11. Effect of mold surface temperature on density distribution for a vertical rise.

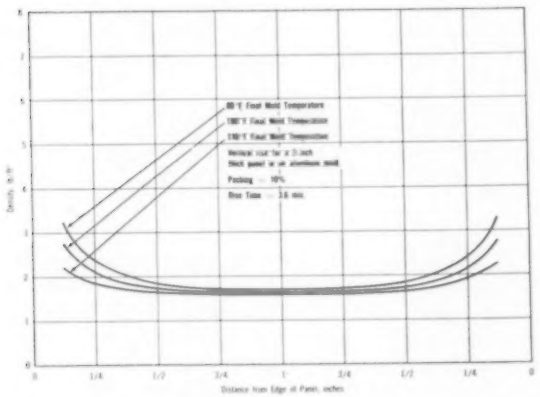


Fig. 10. Density profile.

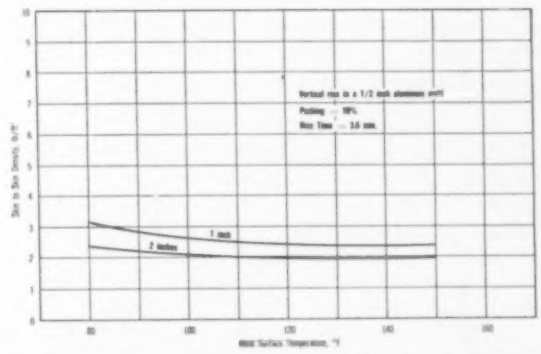


Fig. 12. Effect of panel thickness and mold surface temperature on skin-to-skin density.

with the recommended 10-15% packing. A power driven conveyor and machine mix are required. For wide panels, a traversing mixing head is recommended.

Regardless of pour direction freshly blended material, as a general rule, should not be poured onto material that is already rising. For a pour with an non-traversing head, the maximum charge is fixed by the handling time and output. For example, the maximum charge for a machine whose output is 40 lb/min., and a formulation whose maximum handling time is 35 seconds, would be 23.3 lbs. For a traversing head, a similar relation exists depending also on the traverse speed and traverse distance.

FOAM STRUCTURE. In a vertical rise, the drag along the skin causes shear flow lines. This results in a layer with poor cell structure slightly separated from the skin. Also, air entrapment at the surface is likely as the foam rises. With proper laydown, the rise height and maximum flow distance in a horizontal pour is only a few inches so that the shear lines are practically nonexistent. This has the further advantage that the rise direction (the strongest) is perpendicular to the facing. Thus, advantage is taken of the strongest direction to resist internal cell pressure changes. It is necessary that a stiff rail be placed around the panel edge to resist pressure changes perpendicular to the rise height.

MOLD DIMENSIONS AND CONFIGURATION. The principal factors of interest are the maximum and minimum cross sections, height of rise, and shape.

The maximum cross section for a 2 lb/ft^3 foams is limited only by the quantity of material which can be properly mixed and dispensed within the handling time. Pours up to 24 inches thick have been made with 2 lb/ft^3 foam without discoloration. Since the maximum exothermic temperature is obtained asymptotically in 6 to 8 inches (at standard reaction rates), there is no limit on cross section because of heat of reaction. Since pours 4′ x 8′ x 2′ high have been made without any foam defects such as splits, there is apparently no foam structure limit on large cross sections.

The minimum cross section and height of rise are interrelated. As the section narrows or as the height of rise increases, the restraint on the foaming system increases. For cross sections of 1 inch or less and a rise of 24 inches, both density and foaming pressure are increased. While compensation for density can be made with extra blowing agent and stronger molds, the resulting increase in internal cell pressure would be expected to increase the dimensional instability at elevated temperatures. For cross sections of less than 1 inch, special dispensing techniques to make the foam rise a small distance are recommended. An example of this would be horizontal laydown on a sandwich skin.

The configuration of the part is important with respect to the ability of the foam to flow into corners without trapping air. Foaming pressures do not eliminate air pockets. Unless the mold has numerous air leaks in it, specific provision must be made for air escape. The foam normally has a crown in the least restrained areas. Venting must be provided in areas other than the crown, i.e., in the final volumes of the mold to be filled.

PACKING results from placing an excess of material beyond that required to just fill a restrained mold. Some packing of the mold is desirable. It not only improves the physical properties (dimensional stability) at the corners and edges of a mold, but also allows for some manufacturing variables while maintaining good fill. Excessive mold pressure due to high amounts of packing not only requires heavier mold construction but also tends to worsen high-temperature dimensional stability and in some instances, density distribution. Packing also affects the mold cycle.

For tight control on fluorocarbon content, mold and component temperatures, and other variables, the recommended packing is 10%. However, due to inherent inaccuracies in measurements, the control could vary as much as 5% so that packing up to 15% might be necessary. If packing is not practical, a free rise may be used providing that a formulation with a higher cup density is selected. This results in a panel density that is higher than the packed density for H-602. Slight shrinkage still persists near the top of the rise.

For packing of 10% or more, the packing virtually determines the mold pressure for 2 lb/ft^3 foams. Under good mold conditions, packing results in densification directly proportional to the amount of packing. That is, 10% packing results in a 10% increase in panel core and overall density. Under mold conditions where the surface temperature remains over 100°F., packing does not change the density distribution. However, with low final mold surface temperatures of 90°F., or less, and with large amounts of packing (greater than 20%), extreme surface densification can occur. Such a surface densification would cause less packing in the core than that calculated.

TEST PROCEDURE. Because the extent of packing is affected by almost all application variables, it becomes expedient to define packing empirically. Theoretical calculation is possible, but impractical.

Percent packing is defined as the amount of material used in excess of the material required for an unrestrained pour. An unrestrained pour has an edge removed so that any excess can leave the inside dimension of the mold. In some cases numerous excess holes might be used to simulate an unrestrained pour.

The calculation that follows is based on the dispensed weights and excess weights, rather than the weight of the foam panel. This is better for several reasons. It avoids having to calculate the mold cavity volume or having to remove the mold for weighing. It eliminates the necessity for weighing the foam with a heavy mold or skin tared. Also, correction for the buoyant effect of air, which would require knowing the foam volume, may generally be neglected.

Let:

W_i = weight of system dispensed for initial unrestrained pour, in pounds.
W_e = weight of excess foam removed to inside dimension of open edge, in pounds.
W_f = weight of dispensed material required to pack to a specified percent, in pounds.
P = percent packing.

For a batch mix W_i and W_f refer to the total quantity of components weighed into the mixing container. No weight correction for the residue remaining in the mixing container is necessary, providing that the residue is constant on successive pours. To obtain good consistency in the quantity of residue, it is recommended that the mixing container be scraped as the mix is poured.

For 12% packing:

$W_f = 1.12\ (W_i - W_e)$ (1)

As an example, a trial charge (W_i) of 1.33 lb. was used for a free rise in a panel. At the conclusion of the reaction, an excess (W_e) of 0.10 lb. of foam was obtained by trimming the excess from the mold. What charge (W_f) should be used for 12% packing?

$W_f = 1.12\ (1.33 - 0.10) = 1.38$ lb.

There are several points to be noted in using this method of calculation:

1. Since fill is affected by a number of process variables, it is important that they remain constant for successive pours if the calculated packing is to be realized. These variables, including component and mold surface temperatures, are discussed in the next section under Mold Design Criteria.

2. The excess obtained on the initial pour (W_e) should normally be no more than 20% of the initial weight (W_i) to minimize errors due to the buoyant effect of air. If a correction for air buoyancy is desired, it is as follows: Dispensed weight of excess $= W_e + 0.02V$. Where V = Volume of excess in cubic inches.

For a 2 lb/ft³ foam, this correction amounts to about 4% added on the weight of the excess foam. It should be noted here that the error in neglecting the correction for air buoyancy is conservative in that it results in greater packing (equation 1). This error would then tend to compensate for mold deflection.

3. The excess should be removed at the inside dimension of the exposed edge.

4. If the foam pulls away from the sides or fails to fill out corners, this volume must be taken into account. This can be done by removing a section of the excess equal in volume to the unfilled space. The amount of the correction should not exceed 5% of the weight of the excess.

5. Any expansion in the restrained mold due to packing pressure reduces the amount of packing. For excessive mold deflections an additional amount of material will be required in the delivered weight to correct for this. Excessive deflection in a previously calibrated mold may indicate a change in the components, charge, or mold conditions.

6. For final mold surface temperatures below 100°F., the panel core density may not reflect the packing percentage based on the cup core density due to surface densification.

Any variable that changes the effective charge of material changes the packing. There are three groups of variables. The first is the precision of the charge delivered, or the ability to deliver the same charge on successive pours. This refers to the metering and timer precision on a machine mix, and weighing the dispensing accuracy on a mechanical mix. The second group of variables include all factors that change the cup core density or the panel density distribution. The most important of these variables are changes in fluorocarbon content, final mold surface temperature, and average temperature of the components. The third type of variable is the mold. This includes variation in the cavity volume from mold to mold, or degree of closure.

Because of the number of variables that affect packing in a panel and the importance of its control, some monitoring of packing is desirable. The most direct method would be to measure mold pressure by installing some type of deflection on pressure sensing device on each mold. Thus, once the unrestrained and restrained pours have been made for the prototype, a direct measure of uniformity of packing on successive pours would be available. On experimental molds in the laboratory, 0.001-inch dial gages have proven satisfactory. In production, a high degree of sophistication could be realized by using electromechanical strain gages and automatic recorders.

Mold preparation & cycle time

Surface treatment

Mold and sandwich skin surfaces may be treated to improve adhesion or release. A surface treatment is generally required to obtain foam to metal adhesion equal to the foam strength. Cellulosic materials such as wool and untreated paper do not require surface treatment, however, since they form a natural mechanical and chemical bond with the foam.

The rate at which the maximum skin adhesion or good release is obtained depends on the theoretical minimum mold cycle and the final mold surface temperature. As discussed in the section on mold cycle, good skin surface strengths are obtained in the minimum mold cycle time for the H-602 system when the final mold surface temperature is 140°F., or higher. Peeling a sandwich skin and noting the amount of foam remaining on the skin is a good test of adhesion, but is only valid after the foam has reached its final strength. "Apparent" adhesion is a condition where a quantity of foam sticks to a skin not due so much to good adhesion as to poor foam strength near the surface. This condition is likely for low mold temperatures, such as 100°F., when sufficient time for cure has not elapsed.

Surface treatment affects the foam skin structure in a vertical rise. If the foam adheres to the sandwich skin surface, the crown of the rising foam tends to fold out or blossom. Thus, fresh foam is continually exposed at the top of the rise. When a release agent is used the foam rises like a plug pushing the top skin surface ahead of it. In this case, a great deal of air is trapped along the skin since the top section of the "plug" does not usually touch both skins at any given time. It tends to alternate from side to side during the rise.

RELEASE AGENTS, nearly all polished metal surfaces will release foam. However, the release may be improved by the application of a wax such as Simonize. After several coats of wax have been applied for successive pours, several additional pours can usually be made without further waxing.

ADHESION of foam to metals may be improved by two types of treatment: dipping to obtain a chemical etch and surface treatment by primers or mechanical abrading. Dipping involves immersion of the entire skin in a series of baths; a cleaning rinse, water wash, etching dip, and a final water wash. A water break test is used to determine cleanliness. If the water forms a smooth layer without "breaking" into droplets, the surface is assumed clean.

Following the dip treatment, the panels must be used within 8 hours. There are numerous types of etching components. A phosphoric acid dip has been used suc-

cessfully on aluminum and steel. When immersion of both skin surfaces is not convenient due to fiinshes already applied, a primer or mechanical abrading is used. Under some circumstances, it may be posible to chemically etch one side of a facing by spray application of the chemical.

The primer must show good adhesion to both skin and core. Prior to applying a primer, the metal surface must be cleaned and, in some instances, abraded or treated chemically. At the time of foaming the primer is dry and fully cured. Although "adhesives" are sometimes used as primers, they too are set at the time of foaming so that they are not adhesives in the usual sense. Good foam cannot be obtained against a primer that is tacky due to the presence of solvents. Foaming can be accomplished against solvent free primers. Woolsey Washcoat Primer has been used successfully on aluminum, stainless steel, and steel.

Mechanical abrading includes sandblasting and sandpaper techniques. It is an effective way to obtain good adhesion, but is generally considered to be a more costly and messy operation.

Mold cycle time

Mold cycle time is defined as the length of time, after the start of the mix, required for the foam to achieve sufficient physical properties to be removed from the mold or restraining jig and stacked or stored under the existing ambient temperatures. In order to make this definition more meaningful, definitions will be given for minimum physical properties and the theoretical minimum mold cycle time.

Minimum physical properties are those levels necessary for dimensional stability and sufficient strength for the part to be handled. The foam must be stable at room temperature (65-100°F.). If the mold cycle time is too short for the process conditions used, the foam may expand (or shrink) as the mold restraint is released. Ideally, the foam should also be stable under the extremes of storage, i.e., from 0°F., in winter and 160°F., in summer. This enables the parts to be moved outside which is quite an advantage if you are filling large items like trucks or tank cars. The foam should have sufficient cure to provide adequate strength for handling and stacking. Since H-602 goes through a friable stage, this condition acts as a criterion for finger marks and skin adhesion. A friable surface crushes easily and has poor impact resistance.

Minimum mold cycle time is defined as 1½ times the theoretical time to maximum exothermic temperature. The theoretical minimum mold cycle time is affected mainly by catalyst concentration for a given system.

Fig. 13. Mixing blade for control density. Diameter of disc equals 2 inches.

The degree to which this minimum time can be realized will depend on the final mold surface temperature, packing, and the minimum physical properties required.

In order to investigate these variables, a laboratory scale test was devised using a 12″ x 12″ x 2″ thick vertical rise. The test mold is described in Appendix III. The foam conditions for H-602 resulting from several combinations of final mold surface temperature, packing, and mold cycle times are as follows:

A. Recommended conditions:
   Final mold surface temp. = 140 to 160°F
   Packing = 10 to 15%
   Mold cycle time = 15 min.

These process conditions result in a foam that is not friable and whose expansion is less than 1% on removal from the mold. Exposure to 160°F., or O°F., results in a dimensional change of less than ± 1%. Although a non-friable foam is obtained in 11 minutes (theoretical minimum mold cycle), about 4% expansion occurs on removal from the mold unless the packing is reduced to less than 5% (partial restraint).

B. Reduced Temperature Conditions:
   Final mold surface temp. = 100°F
   Packing = 10 to 15%
   Mold cycle time = 40 min.

These process conditions result in a foam that is friable, but whose expansion on removal from the mold is less than 1%. The foam remains friable for about 1 hour and requires an ambient cure of about 24 hours before dimensional change at both 0°F., and 160°F., is less than ± 1%. Shorter mold cycle times result in expansion on removal from the mold.

Mold design criteria

Pressure at 10-15% packing, a density of 2 lb/ft³ in a 2-inch cross section and up to an 8-foot rise is contained by a pressure of about 2 lb/in². Using a 100% safety factor, the mold deflection corresponding to 4 lb/in² should not be in excess of the required surface flatness.

Pressure Measurement. Monitoring pressure by deflection measurement (or other means) on molds is recommended as a continuous control on any changes in process variables.

Air Escape and Access Holes. Provisions for air escape must be made at the final regions in the mold to be filled. Although access holes must be provided to place the charge of material in the mold, provision must be made for capping them so that there is no flow of foam "excess" through these holes.

Final Mold Surface Temperature. Control of the mold surface temperature is essential. Thermostatically controlled molds are recommended. If low heat flow molds are used, a reproducible mold surface temperature cycle must be obtained. Final mold surface temperatures of 140-160°F., are recommended. The precision of control should be ± 5°F., below 130°F., and ±10°F., above 130°F.

Thermal Expansion of Panel Skins. Allowance must be made for expansion and stability of skin surfaces and the metallic mold surface under the exposed temperature.

Thermal Contraction of Foam. Allowance in mold dimensions may be made for thermal contraction of the foam (and skin) on cooling. Initial measurements gave a result of 0.5% expansion followed by 1% shrinkage.

The shrinkage fits approximately the coefficient of thermal expansion of 3.5 x 10^{-5} per °F.

Metering and mixing

The desired accuracy for metering or weighing the components is ± 1%. In batch mixes, prepolymer and resin are weighed into the mixing container on a balance having the proper range. Resin temperature should be below 75°F., so that no fluorocarbon volatilizes.

Machine pumps are calibrated by dispensing for a known time interval into tared paper cups with the mixer head removed. If possible, both components are dispensed simultaneously to minimize dispensing time errors.

Since the pressure of the liquids in the lines may affect pump output the pressure of each component must be kept constant during the recirculation and dispensing cycles. Pressure gages are installed on the inlet side of the mixing head, and needle valves on the outlet side. Orifices in the mixing head ports should be adjustable so that the pressures can be balanced during both cycles. The simplest way to achieve this is to make the orifice in each port small enough to cause the pressures during the dispensing cycle to be greater than during the recirculation cycle, with the needle valves open all the way. The needle valves can then be adjusted to give the same pressures during the recirculation cycle.

In addition to ensuring a constant rate of pumping, this procedure eliminates a surge or lag in the delivery of the components during the initial portion of the dispensing cycle.

Mixing combines the resin and prepolymer such that a uniform chemical reaction can be produced and allowed to proceed to completion following the mix. It must also provide a good distribution of gas nuclei around which the cells may form. Slow mechanical agitation and hand mixing by spatula are not recommended! They not only produce inferior cell structure, but also generally impair physical properties.

Temperature control of both components is mandatory. The precision required is ± 2°F. This can be accomplished by air conditioning the foaming area and component storage area or by installing heat exchangers on the machine. In the latter case, the resin (containing the fluorocarbon) is cooled and the prepolymer heated. The cooled temperature must be below all ambient temperatures and the heating temperature must be above. The fluorocarbon-containing resin must always be handled below 75°F. Prepolymers have been used at temperatures as high as 140°F.

Because of the low viscosity and miscibility of the H-602 system, the components not only combine easily but the reaction continues to completion without complication. With nonmiscible components, it is sometimes necessary for the reaction to proceed to some threshold temperature to prevent partial separation when mixing is stopped.

A machine mix combines the components in a mixing chamber so that a continuous stream of mixed material is dispensed from the chamber. A power driven blade is used in the mixing chamber. The exit temperature for a machine mix for the H-602 system is essentially the average temperature of the components prior to mixing.

Good gas nucleation is necessary for proper cell size and structure. In a machine mix, this may be accomplished by direct air injection into the mixing head. In some instances, a small hole is drilled into the head to provide a controlled air "leak." Air leakage around the packings sometimes provides the necessary gas. However, this is not recommended as a sole source since it will vary with the tightness of the bushing and wear on the packing. For a given system, keeping the mixing head, formulation, and pressure constant, the cell size and configuration are determined by the mixing speed and air injection. A mixing speed of 4375 rpm. is generally recommended when using the lab size, DuPont type mixing blades.

Machine mixes are more efficient for continuous production since there are no losses due to residual material in the mixing container. Mechanical or batch mixing combines the entire charge simultaneously by agitating with a power-driven mixing blade. A standard mechanical mixing procedure is given in the Control Density Test Appendix II. Recommended mixing time for one pound or less of materials is 15 seconds. Amounts larger than one pound may lengthen the mix time and require improved mixing equipment.

Mechanical mixers vary in size and shape from small electric drill motors with mixing blade attachments to large motors with flexible shafts and mixing devices attached. The size of the motor depends upon the amount and viscosity of the material being mixed. The mixing speed, mixing blade, mix time and beating action influence the cell structure for a given system. The standard mixing speed is 1,500-2,000 rpm.

As with a machine mix, good nucleation is necessary for batch mixes. Poor nucleation results in a coarse cell structure. This condition may exist where the batch volume is large compared to the diameter of the mixing blade. Adequate nucleation may be achieved by additional mixing, raising the mixing blade near the surface of the mix to whip air into it, or a combination of the two. Care must be taken to prevent inclusion of large pockets of air when the mixing blade is near the surface.

Batch mixes are generally used for limited production, or where a machine of sufficient capacity is not available. Batch mixes of 100 pounds of the H-602 system have been made successfully.

Test procedures

Appendix I—Fluorocarbon content test

In order to provide a fast, non-destructive test for fluorocarbon content, a procedure utilizing a hydrometer

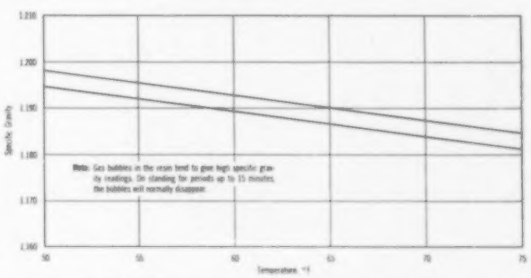


Fig. 14. Specific gravity vs. temperature for H-602 resin.

has been established. It consists of measuring the specific gravity of a resin-fluorocarbon mix and using the temperature curve to check fluorocarbon content.

Apparatus

1. Hydrometer—a hydrometer calibrated in divisions of 0.001 is used. Scientific Glass Apparatus Company Cat. No. H-7825 1180/1250, pictured in Fig. 15, is recommended as a float type in the range of 1.180 to 1.250. The calibration of new hydrometers should be checked against a liquid of known specific gravity or a previously calibrated hydrometer.
2. Thermometer—a thermometer calibrated in 2°F., increments is used.

Procedure

1. Conditioning—prior to the test, the liquid sample must be conditioned so that its average temperature is below 75°F.
2. Specific Gravity Measurement—stir the resin with a thermometer to assure uniform temperature and record temperature. Before placing the hydrometer in the mix, it is desirable that its temperature be that of the fluorocarbon to minimize the formation of bubbles around it. Care should be taken to handle the hydrometer by the stem so that the temperature of the bulb is not raised by body heat. Lower the hydrometer slowly into the mix and allow it to settle to a constant level as shown in Fig. 15. The hydrometer is considered to be at its equilibrium value when it changes no more than 0.005 units in 5 minutes. Equilibrium is obtained after all gas bubbles have disappeared. In some cases, 15 minutes may be necessary to reach equilibrium. The hydrometer is read at the top of the meniscus. The numbers on the hydrometer scale correspond to the line under that number. Record specific gravity to 4 significant figures. While the test is a simple procedure, the following items should be noted as possible sources of error:
   a. The hydrometer should be at least ½ inch from any surface of the container in its final position.
   b. Any gas bubbles in the mix or on the surface of the hydrometer tend to give high fluorocarbon values.
   c. If fluorocarbon is being added to the mix, be sure that it has been dispersed uniformly in the resin. Because of its high density, it tends to settle to the bottom of the container as it is poured.
   d. Temperature gradients in the container will give slightly erroneous values.
   e. Parallax errors can exist if the surface of the liquid is well below eye level.

When the specific gravity has been obtained, remove the hydrometer and wipe it with a paper towel soaked in a solvent such as acetone. The resin mix should be immediately sealed to prevent any loss of fluorocarbon which would invalidate the reading.

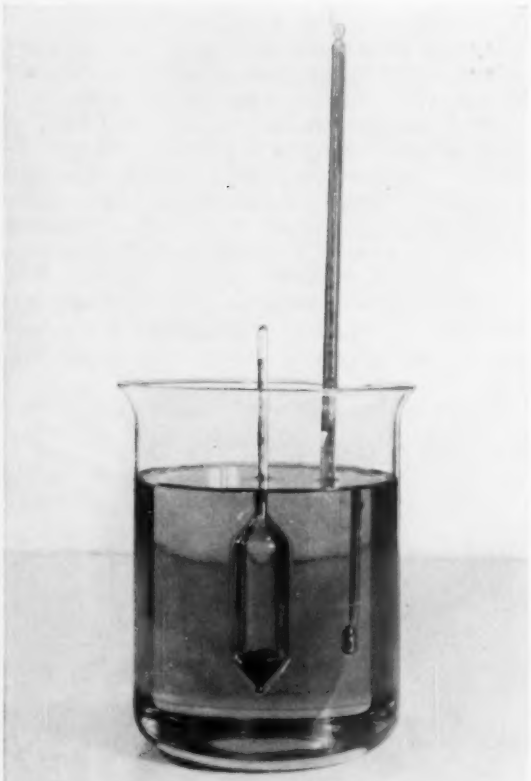


Fig. 15. Hydrometer suspended in polyol-fluorocarbon mix to determine specific gravity.

Values reported and their significance

The specific gravity may be converted to fluorocarbon content through empirical calibration curves for the specific resin. For a single fluorocarbon content, a plot of specific gravity vs. temperature as given in figure 14 defines the area of acceptable fluorocarbon content.

The test is designed for mixes whose viscosity range is up to about 5,000 cps. and for fluorocarbon contents from 5-40%. The precision of the measurement is about ±0.0005 units of specific gravity which corresponds to about ±0.1 parts of fluorocarbon. The overall accuracy including errors in temperature measurement differences in hydrometers, and the specific gravity of the polyol is estimated at ±0.5 parts of fluorocarbon.

Appendix II—Control cup density test

The control cup density test described here checks the chemical components. A mechanical mixer is used, since a machine would introduce additional variables. However, under normal volume production, the test is more likely to be used in conjunction with machine mixes. In this case, those steps involving the weighing and batch mixing of the components are not applicable.

Test procedure

1. The R and T component temperatures are obtained. The recommended average temperature for which the data in Table 2 apply is 73.4 ± 2°F.
2. Preweigh (tare) Lily cup No. 10, which is used for densities below 6 lb./ft³. The cup is manufactured by the Lily Tulip Corporation, New York, N.Y. Since the density calculation depends on the

volume of the cup, a cup selected at random should be calibrated when a new lot is received to verify the density factor. A calibration is described under Calculations.

3. Tare a clean metal can for mixing foam components (1 pt. to 2 qts. capacity—American Can Company). Never use paper or cardboard cups for mixing. The volume of the R and T components combined should not exceed ⅔ the capacity of the mixing can.
4. Weight the specified (Table 2) quantities of conditioned R and T components into the tared can or calculate the length of time required for a machine mix.
5. For a machine mix dispense the material into the No. 10 cup.
6. A batch mix is made using a heavy duty portable drill whose mixing speed is 1,500-2,000 rpm and a 2-inch Conn mixing blade as shown in Fig. 13, or equivalent Conn mixing blades are available from Conn and Co., Warren, Pa.
   The mixing time for H-602 is given in Table 2. To prevent splashing, place the mixing blade below the surface of the liquid components and start agitation. Move the mixer around during the agitation to afford better blending of the components. Be sure materials on the inside of the can are blended while mixing. When mixing time is complete, pour into the previously tared No. 10 cup. Scrape as much as possible from the can with a spatula. The mixing blade should be placed in a container of acetone for cleaning.
7. For the cup density result to be valid, the crown or excess should be similar to that shown in Fig. 5. When the foam has set and hardened sufficiently, cut off excess foam (crown) with a band saw so that the foam is level with the top of the cup as shown in Fig. 5.
8. Obtain weight of remaining foam and cup in grams.
9. Split box vertically on a band saw and inspect cell structure.

Calculations

The calibration for volume of the cup is made by filling with water and obtaining the weight of water in grams. The weight is numerically equal to the volume in cc. (volume of No. 10 cup = 5.520 cc.)
Density Factor Derivation for a No. 10 Cup:
Density =

$$\frac{(W \text{ in gms})}{5{,}520 \text{ cc.}} \quad \frac{(1 \text{ lb})}{454 \text{ gms}} \quad \frac{28{,}320 \text{ cc.})}{1 \text{ ft}^3} =$$

$$0.0113 \text{ W lb/ft}^3$$

Where W = Net weight of foam in grams. (Weight of foam and cup less weight of cup).

Appendix III

Abstracted test procedures for standard and panel foaming characteristics. This section describes in general terms the test procedures carried out at Nopco Laboratories. Detailed discussions are available upon request.

Rise Rate

The test for measuring volume expansion consists of placing a float on a freshly mixed foam and manually recording height vs. time in a cylindrical paper container having a constant cross-sectional area (inner diameter equals 6.75 inches). As with many laboratory tests, the data obtained may not simulate actual application conditions. Such factors as mass, cross-section, height of rise, temperature of mold materials, and average component temperature may influence rise rates. However, the method yields comparative data and is useful in estimating foaming rates in various applications.

Temperature Rate

The test method consists of separating two strands of a thermocouple wire and running one wire out the bottom of the container and the other out of the top. The wire is centered vertically and the foam allowed to rise around it. Temperature versus time is measured automatically with a recorder. Because the temperatures of the initial parts of the reaction are significant, the

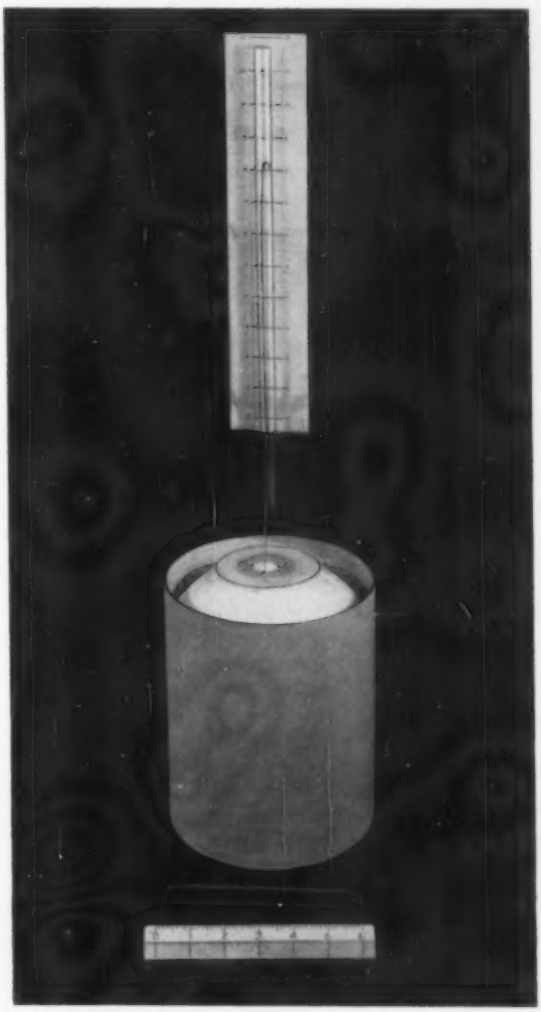


Fig. 16. Rate of rise measuring apparatus. Float rises on foam, which is contained within a paper cylinder of constant cross-sectional area. Height is manually recorded.

Fig. 17. Cure rate mold with aluminum foil covered insert (left). Thermocouple wire leads into plywood face of mold, where it continues through foam insulation and aluminum mold to record temperature of mold surface. On the right, the insert covered with aluminum foil is peeled back to expose foam structure.

junction of the thermocouple is first placed near the bottom of the container, and is pulled upwards as the foam rises, keeping the junction at about the center of the foaming mass. The cross section must be sufficient so that the maximum temperature is reached and remains constant for a time about equal to the time to reach maximum temperature. Under this condition the reaction around the thermocouple is adiabatic (no heat loss) and the temperature change recorded is the maximum for the foam. The minimum cross section at standard reaction rates is about 4-6 inches for 6 lb/ft^3 and higher, and about 6-8 inches for densities down to 1.5 lb/ft^3.

Because heat must be taken from the foam to warm the thermocouple, there is a delay in time between the temperature in the foam and the temperature in the thermocouple. This effect is minimized by the use of a small diameter (No. 30) thermocouple wire and a small weld at the junction. While a glass thermometer will generally give a good indication of the maximum exothermic temperature, there is considerable error in the time to maximum exothermic temperature due to thermal lag.

The time to maximum exothermic temperature is used as a basis for establishing a theoretical minimum mold cycle.

Panel Forming Characteristics

Mold pressure, temperature, and rise height may be measured simultaneously in a panel. In order to obtain these, a panel whose inside dimension is 24″ x 24″ x 2″ is used as a standard test. The rise is vertical and may be restrained or unrestrained.

Rise height and center temperature are measured by the same techniques as used for the standard foaming tests. To measure mold pressure the mold is calibrated by inflating a polyethylene bag inside the mold and noting the bag pressure vs. mold panel deflection. The stiffness of the mold panel is designed so that the foaming pressure results in about 10-25 mils. To measure these deflections a 0.001 inch dial gauge is used.

Mold preheat, mold material and average component temperatures are reported along with the rate curves.

Mold Cycle Time Test

Mold cycle time as a function of variables such as mold surface temperature and packing may be obtained in a ½ inch thick aluminum mold whose inside dimensions are 12″ x 12″ x 2″ thick. The outside of the mold is covered with 1 inch of foam insulation and then conditioned in an oven until a uniform temperature is recorded by a thermocouple on the inside surface of the mold. The pour is made vertically either unrestrained (top shim removed) or restrained (using shim, and with pour hole plugged). The inside of the mold is lined with aluminum foil attached to the shims so that at mold cycle time the foam and shims may be quickly removed for measurement and exposure.

—The End

Molding vinyl footwear
(Continued from page 42)

with a suitable conductor such as graphite or bronze powder. It is then suspended in an electroforming tank for plating with the copper.

Following plating, the top of the mold is trimmed and the rubber skin pulled out. This is known as a sock mold, and it is used with slush molding to produce a heavy vinyl sock. From embossed, calendered vinyl sheet, patterns are cut and adhered to this sock. Decorative strips along vamp and foxing are added.

The model is sprayed with bronze powder, suspended in an electorforming tank, and copper plated. Following this, the top of the mold is trimmed and the model removed. This leaves an electroformed mold with the embossed pattern and design of the model accurately reproduced on the mold interior. Using a master mold and slush molding techniques, a heavy vinyl sock (prototype) is produced. The master mold can be used to produce an unlimited number of prototypes for the electroforming of production molds. —The End

Reinforced plastic casting forms

Casting prestressed concrete beams in reinforced plastic forms overcomes traditional limitations on design of structural beams and panels. Resco, Inc. developed the forms using Archer-Daniels-Midland resin reinforced with fiberglass, and Prestressed Concrete, Inc., fabricated 28-foot beams which were used in a suburban Minneapolis high school.

Aropol 7510 resin resisted shrinkage under the combined heat of concrete curing with steam and the heat given off by the concrete as it solidified. One of the big advantages of the forms are the lack of seams, whatever the length of mold. Because surface textures as well as intricate design can be applied to this type of form, it is adaptable to panels and columns as well as domes and other irregular surfaces.

—The End

EXTRUDERS

The machines currently available, their specifications, and a guide to choosing them.

Recent surveys list about 6000 plastics processing firms in the United States. At least half of this group use screw or plunger type extruders in such operations as: blow molding; wire,- sheet,- and blow film extrusion (layflat); cast film - and/or waterbath-extrusion; expandable plastic,- and monofilament extrusion; pipe and shape extrusion dewatering and devolatilizing plastic materials, adiabatic mixing of plastic materials, multiple color extrusion, piggy-back screw preplastication, screw injection molding, and ram type extrusion. The extruder, in each of the processes named, is a pulse-free pumping unit which delivers a thermally homogeneous melt at a uniform and high rate. The ultimate output of the unit is a function of many variables, including torque, screw speed, and heater capacity.

In each of these operations the extruder represents the largest, single capital investment in the shop—hence PLASTICS TECHNOLOGY'S third Extrusion Machinery Tabulation. Factors to be considered in selecting an extruder include expected output, types of resin used, product diversification, equipment obsolescence, and the suitability of the machine to the existing manufacturing line. The same consideration should also be given to the selection of auxiliary equipment.

Most extruders currently offered use a single screw driven by an electric motor through a gear reduction unit and belts. The plastics industry has relegated the ram extruder to special uses; the wire coating field, for example, still uses it for extruding fluorocarbons onto wire. It is also used to extrude such heat-sensitive materials as cellulose nitrate.

Purchasing

Cost is not necessarily the best index of utility, nor does this imply that least expensive units will have a long life expectancy when continually overloaded or worked on a 24-hour schedule. It stands to reason that the more substantially built machines will give more trouble free performance than machines selling for considerably less money. You will find in the various size categories and according to classification (light duty, heavy duty etc.) that prices are competitive between the designs of one manufacturer and another. Certain refinements command price premiums. Such refinements include quick-disconnect collars for die changing, convenient electrical outlets for die heaters and thermocouples and easily manipulated controls for varying screw speed. Some of these refinements are standard equipment on some models, optional extras on others. Extruder manufacturers also offer as optional equipment valved heads for increasing back-pressure in the cylinder and regulating resin flow, additional heat zone controls, and special undercarriages for retracting the extruder from other process equipment.

Reading the Data Sheets

A prime consideration in selecting an extruder is its output capacity. This appears in our listings as "Extrusion Capacity," and is based on a 0.92 density polyethylene with a melt index of 4.0—the resin in most common use. If extruder conditions could be held equal, differing melt viscosities would make extrusion output greater for nylon than for the 0.92 polyethylene, and less for polystyrene. Such variations also hold true for resins within the same polymer group.

The listings identify extruders by screw diameter, expressed in inches for American-made machines and in millimeters for foreign-made units. In comparing the two, we list a 60 mm. unit with the 2½-inch domestics, although its diameter is actually 0.14-inch less. The most commonly used extruders do not have screw diameters over 6 inches, though special models for mixing, dispersing, and pelletizing may range from 8 to 24 inches. Extruders with conical plasticators made their appearance about a year ago. The innovation reduced the length of the screw required to plasticate the resin: the shorter screw permits a reduction in barrel size and in overall length of the machine. To date no reports have issued from users on the efficiency of these units. Other special-purpose machines include the twin screw units with both meshing and non-meshing screws.

Extruder size, however, depends on its L/D (screw-length-to-diameter) ratio. A machine with a 20:1 L/D ratio, the most common, and a 2½-inch screw has an effective screw length of 50 inches. Extruder output varies with the L/D ratio, screw diameter, pitch, compression ratio, screw speed, and the shape of the part being extruded.

Speeds range 10-400 rpm. in the smallest machines, the maximum speeds falling off as the screw diameters increase. An 8-inch machine generally has a maximum screw speed of 75 rpm. Output is about 1000 lbs/hr. with a motor of more than 200 hp. Outputs vary from 1 lb/hr. at 1 rpm. (100 lbs/hr. at 100 rpm.) for a 2½-inch machine to about 15 lbs/hr. at 1 rpm. for an 8-inch machine.

Several improvements have been made in extruder designs in the past year that have improved product quality

and increased production rates. Machines of the same diameter and L/D ratio as those made a few years ago are now working at a 25% increase in output. Among the improvements responsible for the increased output are screws which can support higher torque, drive gear arrangements that operate at higher speeds and efficiencies, and better heater locations with adequate provision to cool both barrel and screw when temperatures rise above desired limits.

The latest trend in extruders is away from the general purpose machine and, according to manufacturers, toward more specialized machines. This trend is particularly evident in the larger sizes, those above 3½-4½ inches. The trend is less evident among the smaller, more common sizes, where special purpose parts can easily be tailored or supplied from stock. Such modifications as special bases to increase the height of the extruder so that it will align with a blow molding attachment, or brackets for supporting odd shaped, pendulous die heads are commonly required.

Maintenance & Safety

Down-time in an extrusion operation can be very costly. A machine with built-in safety provisions such as shear pins and overload cut-out relays will save a processor many times their cost. These safety devices are particularly advantageous when machines are operated by semi-skilled and unskilled workmen. A familiar example of this is when an operator starts up an extruder loaded with resin before the heaters have had time to reduce the viscosity of the plastic. When a machine is not protected by a shear pin, the high driving torque may shear the screw shaft, or the pressure of semi-solid material may push the die from its mounting, shearing hold-down bolts and generally creating sufficient havoc to stop production for more than a day.

When choosing any capital equipment, particularly high speed machines used in continuous operations, ease of maintenance is a prime requisite. An extruder that requires infrequent, easily accomplished maintenance pays dividends by increasing production time.

The importance of a properly designed extruder head and gate to avoid cold spots and consequent heat loss in the material should also be stressed. Easy die removal to facilitate screen changes always tends to reduce down-time. Not all machines are equipped with head and gate heaters. When these are available, they are particularly useful in reducing start-up time after changeover or maintenance stops.

Most extruders have some provision for screw removal from the front. Easy access is important for fast changeover of screws or when a screw is to be removed for cleaning. Screw change is generally required whenever materials of widely different melt viscosities are to be run consecutively.

For some of the operations previously mentioned, Nitralloy cylinders in combination with flame hardened screw flights would normally suffice. Other, more exacting operations like the manufacture of ABS or unplasticized vinyl pipe require less maintenance if the extruder is equipped with an Xalloy-lined barrel in combination with stellite-tipped screws. Besides the abrasiveness of some plastic compounds, vinyl processors have to contend with corrosive break-down products being formed in the barrel.

Screws

The screw is the main functional part of the extruder. As recently as 10 years ago, a processor could extrude all of the few thermoplastic materials then available with a metering type of screw of constant (lead) pitch. It is very much to the machinery manufacturer's credit that this type of screw still remains as the best unit for certain plastics, namely nylon. Both machine manufacturers and plastic processors recognize that there is no perfect universal screw which will provide optimum performance with all the resins available today.

The configuration of an extrusion screw, in order to attain maximum output, must be adapted to the melt viscosity of the resin. This requires not that there be a different screw for each material but that the design be such that a particular screw be capable of handling the greatest number of polymer variants.

Many extruder manufacturers offer interchangeable screws with different compression ratios and pumping heads thus enabling a processor to obtain optimum feed characteristics with specific resins. Compression ratio is an expression of resin volume between screw flights just forward of the hopper feed-section to the volume between flights at the discharge end. This distance is the effective screw length. A basic screw consists of three work zones: feed transport, compression or melt conveyor, and, the metering or pumping section.

Heaters

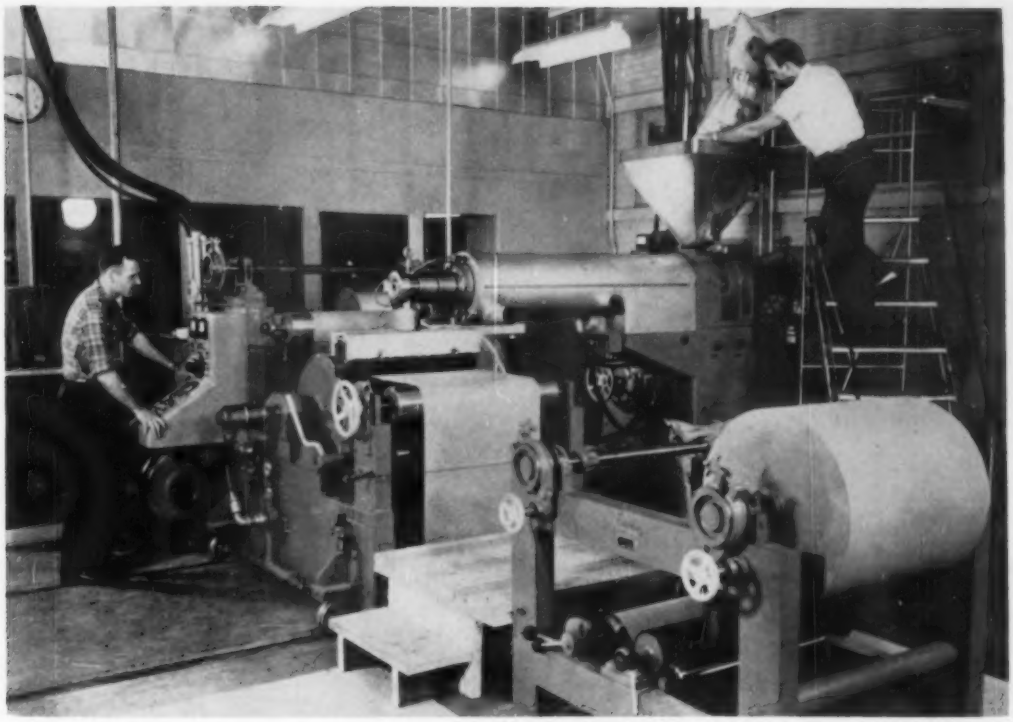
The types of heaters used on extruders include electrical resistance, steam and hot-oil-jacketed, and electric induction. Resistance heating is still the most popular method, since it contains the simplest units and is easiest to install. Fluid heating, however, offers other advantages. Heat can be supplied more uniformly and with lower local temperatures than by other means, thus hot spots can be avoided. A liquid system, moreover, can absorb as well as supply heat, making cooling easier. The other systems use air blowers, sometimes with cooling coils, to remove heat from the cylinder.

Instrumentation

When selecting any heating methods, give careful consideration to the type of instrumentation needed for controlling the cylinder temperature during extrusion. Three basic types of controllers are available; the on-off, the proportioning type, and the saturable core. The on-off type is the simplest: it switches off current upon receiving a signal from the thermocouple. For example, a signal will turn off the current at 400°F. but will not turn it on until the temperature has dropped to 350°F. The proportioning type controller adjusts the period of current flow to the heater in a cyclic manner so that it is reduced as the preset temperature is approached. This type of control reduces the probability of temperature over-ride. The saturable core reactor controller is also a proportioning type, but regulates the heat by adjusting the amperage instead of the "time-on" period. All three types have been used successfully to control heat. When extremely accurate temperature control is desired, the more costly saturable core controller should be used.

Hoppers

Hoppers for extruders should be large enough to contain resin for at least an hour's operation. The hopper is basically a truncated metal cone or pyramid



Extruding a coating of low-density polyethylene onto paperboard is shown. Paperboard substrate unrolls from right, passes over idler roller (middle) and feeds between a rubber compression roll and a highly polished chill roll, the nip, (behind idler roller) where polyethylene melt is laminated on.

that sits over the feed opening and directs the flow of material into the cylinder feed-pocket. Hoppers vary in size, shape, and complexity of design; the latter contain baffles and other means for circulating hot, dry air through the resin granules.

Many extrusion firms purchase resin in bulk and store it in huge bins whence it is air-conveyed directly to the hoppers. Smaller operation, if they are continuous, require almost the same kind of device—an automatic hopper loading mechanism to feed material from an adjacent storage drum to the hopper. In addition to labor savings, such closed resin transport systems keep contamination and spillage to a minimum and save handling costs.

It is imperative that the air used for transport or drying be absolutely free of water and oil. This may require the addition of an oil separator, filter and dryer to an existing air system.

Special Purpose Machines

Dewatering and devolatilizing extruders are primarily used by resin manufacturers in operations prior to pelletizing. In this and other operations it is often necessary to extrude resins which contain moisture, solvents or adsorbed gases. Unless these volatile materials are removed before resin leaves the die, bubbles will form in the extruded product. Two kinds of extruders are presently offered. The more conventional of the two provides a vent port in the cylinder wall and requires a special screw with at least two metering or pumping sections. Between the two low-volume conveying sections, a deep high-volume section runs half empty. In this section, under reduced atmospheric pressure and heat, volatile materials are removed without losing resin. The second type has its extraction port in the screw shaft instead of in the barrel. A third unit, still being developed, is a by-pass, venting type.

Mixing extruders are highly specialized units used in the manufacture of color concentrates and other operations requiring compounding, such as vinyl processing. These machines range from modified standard extruders with special mixing heads extending from ordinary screws to special fluted screws used with fixed vanes on the interior of the barrel.

The latest use of the intermittent discharge type is in screw injection molding. Here the screw moves linearly and freely through a long, splined shaft, driven by an electric or hydraulic motor through a stationary female spline which engages the screw shaft. The screw is rotated—volumetrically displacing itself backwards with plasticated resin. When a full charge is stored, rotation stops and a hydraulic cylinder pushes the screw forward causing the pumping section of the screw to act like a ram in an injection operation.

Manufacturers generally provide customers with an opportunity to view their machines in action, occasionally in the manufacturers' plants or in another extrusion plant. At other times, they may be on demonstration in the resin producers' laboratories. Seeing a machine in operation affords a better understanding of the equipment than any amount of descriptive literature.

Advanced planning, with thought given to location, flexibility or versatility, maintenance, safety, and what must be accomplished by the extruder, will result in an efficient production set-up.

—Lee Zukor

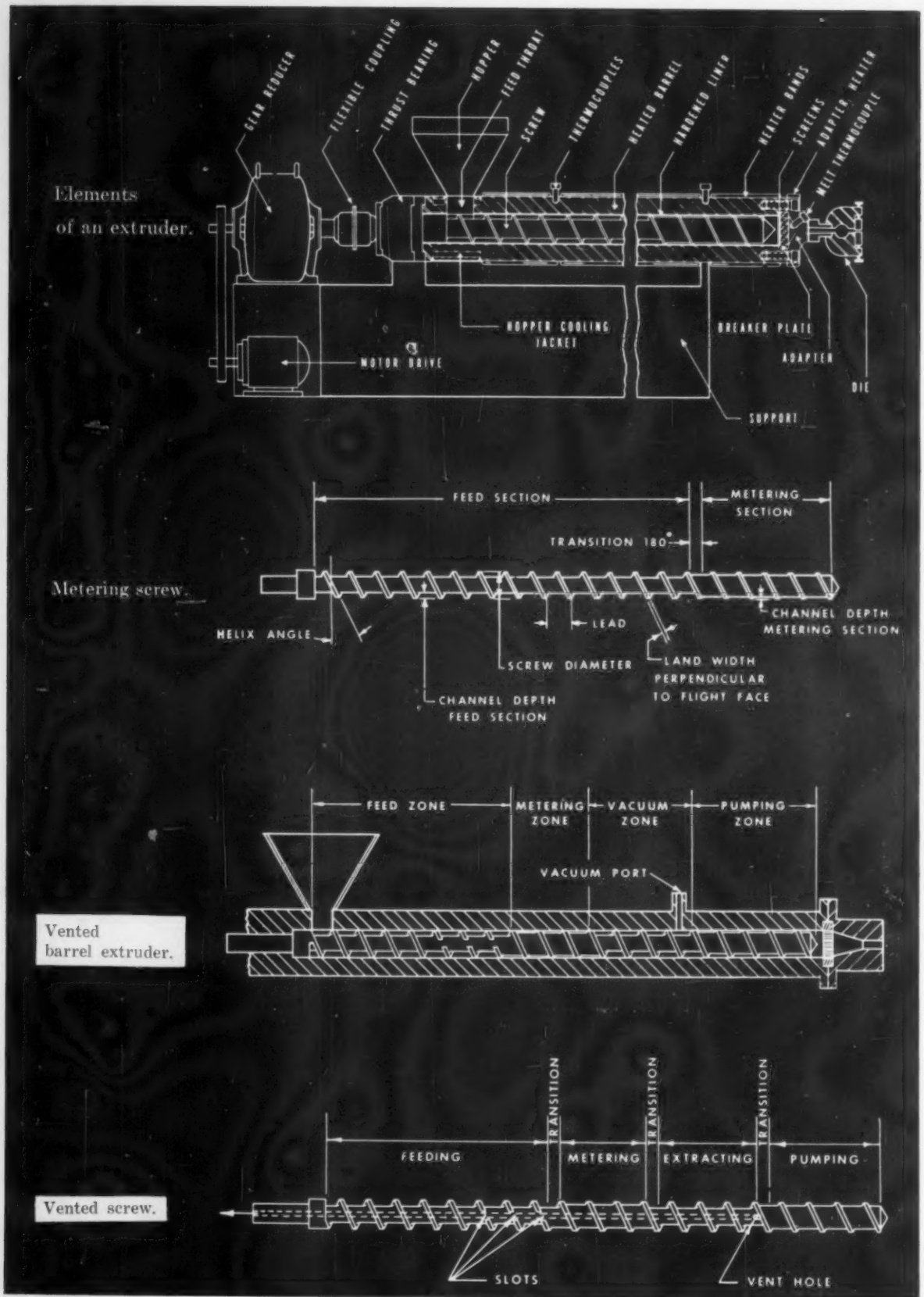


Diagram courtesy Society of Plastic Engineers, Inc.

PT's Comparative Data on 1961 Extrusion Machines

(Based on data submitted by the machine manufacturers)

	Aetna-Standard#						Atlas		
Manufacturer*									
Machine model	IM25-24PH-500* (2½")	IM35-24PH-500* (3½")	IM45-24PH-500* (4½")	IM60-28PH-500* (6")	IM80-24PH-500* (8")	SML2-10CP-20* (12")	1" Lab.	2½"	3"
Screw: Number	One	One	One	One	One	One	One	One	One
Design type	To meet application & resin or to customer's special requirements.						3-zone metered type.		
Effective length, inches	63½	85	108;131½	144;168	198	120-240	19½	49-3/8	69⅝
L/D ratio, excluding feed opening	25.4:1	24.3:1	24.1; 29.2:1	24:1;28:1	24.8:1	as req'd.	Choice of 20:1 or 24:1		
Speed range, rpm.	10-200	10-200	10-200	10-250	8-150	8-80	0-125	12-120	10-100
Materials (base & surfacing): Screw	Alloy steel, screw flights flame-hardened, chrome-plated.						Heat-treated 4140 alloy steel.		
Cylinder	Alloy steel tubing with Xaloy or Xaloy 306 lining.						Steel with Xaloy liner.		
Gear reduction type	Double-reduction herringbone type.						Spur	Herringbone.	
Torque, foot pounds @ 100 rpm.	2,580#	5,250#	10,800#	16,700#	25,000#	as req'd.	5,000	10,000	10,000
Thrust carrier: Type	Roller bearing.						Self-aligning spherical roller.		
B-10 service life,** hrs. @ 100 rpm. & 5,000 psi. pressure##	143,000	110,000	140,000	63,000	190,000	5-year min. life	28,000	52,000	61,000
Extrusion cylinder: Number of heating zones	5##	5##	5,6##	6,7##	6##	6##	2;3	3;4	4;5
Max. kw. demand on cylinder	15	29	58.6;68.6	93.6;105.6	169	- - -	3	15	28
Lubricating system	Dip and splash.						Forced oil pressure.		
Drive motor, hp.	25-40**	50-75**	125-150**	200-600**	300-600**	250-1250**	5	15 or 25	30 or 50
Extrusion capacity, lbs./hr., based on polyethylene (mol.wt. 20,000, melt index 4.0, sp.gr. 0.92) @ 500 ± 10° F. with output rate held to ± 1%.	150-250**	300-450**	600-900**	1,200 - 2,000**	1,800 - 3,000**	3,000 - 5,000**	40	140	300
Approx. heat-up time, minutes for room temp. to 500° F. (for polyethylene above).	40***	45***	50***	60***	60***	- - -	20	30	30
Heaters: Type	Induction coils.###						Band or cast aluminum.		
Controls	Three-position, proportioning, with thermocouple break protection and close temp. control over 0-800° F.						Proportioning.		
Special features (included as standard)	Thrust capacity up to 10,000 psi. Leak-proof, quick-opening, h-p head. Base designed to accommodate coating dies. Stock-pressure gauge upstream from valve						- - -	- - -	- - -
Optional features (avail. at extra cost)	Special screw designs, L/D ratios, and extruder sizes from 1½-24". Pelletizers. Screen pack changers. Drive selection. Special feed hoppers. Overhead die supports. Pressure transducers.						Air- or liquid-cooled cylinder.		
Approx. floor space (LxW), feet	12½ x 6	17 x 6	20 x 7	20 x 7	28½ x 9	36-50x12	2½ x 4	3 x 7½	3½ x 10
Approx. delivery time, weeks***	Varies from 8-20 weeks.						4	4 - 6	6 - 8

* Induction heated, high pressure (10,000 psi.) 900 line extruders.
** Varied to suit individual requirements.
*** Includes normal soaking time for cold polyethylene, starting with a cold extruder. 50% less time for an empty extruder.
\# With 1.25 service factor.
Includes one zone on head.
Induction coils are tapped to provide a range of input kw.

* Complete company names and addresses are as follows:

Aetna-Standard extruders are made by Hale & Kullgren Plastics Dept., The Black-Clawson Co., 613 E. Tallmadge Ave., Akron 9, Ohio
Atlas Molding Machine Corp., Box 58, 257-259 Hackensack Street, East Rutherford, N. J.
Battenfeld Corp. of America, 959 W. Grace St., Chicago 13, Ill.
Bolling, Stewart & Co., Inc., 3190 E. 65th St., Cleveland 27, Ohio
Davis-Standard, Div. of Franklin Research & Development Corp., Mystic, Conn.
Frank W. Egan & Co., South Adamsville Rd., Somerville, N. J.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Killion Tool & Mfg. Co., 56 Depot Street, Verona, N. J.
Luigi Bandera extruders are made in Italy and sold in U.S.A. by The Rainville Co., Inc., 839 Stewart Ave., Garden City, L.I., N. Y.
Modern Plastics Machinery Corp., 64 Lakeview Ave., Clifton, N. J.
National Rubber Machinery Co., 47 West Exchange St., Akron 8, Ohio
Olympia Tool and Machine Co., 119-121 Delancy St., Newark 5, N. J.
Prodex Corp., King George Post Road, Fords, N. J.
Reifenhauser extruders, made in Germany, are sold in U.S.A. by Heinrich Equipment Corp., 111 Eighth Ave., New York 11, N. Y.
John Royle & Sons, 10 Essex Street, Paterson 3, N. J.
Sterling Extruder Corp., 1537 W. Elizabeth Ave., Linden, N. J.
F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.
Waldron-Hartig Div., Midland-Ross Corp., P.O. Box 531, Westfield, N. J.
Wayne Machine & Die Co., 23 Grand Street, Garfield, N. J.
Welding Engineers, Inc., Norristown, Pennsylvania
Werner & Pfleiderer Corp., 500 Fifth Ave., New York 36, N. Y.
H. H. Windsor of Canada, Ltd., 56 Advance Rd., Toronto 18, Ont., Canada

** Life expectancy of 90% of all bearings.

*** Delivery time, as well as prices, should be substantiated in a formal quotation from the manufacturer.

\# Has more machine sizes, in addition to tabulated models.

Note on how speeds and pressure affect the B-10 life of thrust bearings. B-10 life is inversely proportional to the speed; B-10 life is cut one-half when speed is doubled. B-10 life is inversely proportional to the cube of the pressure (total force); when pressure is doubled (the load on the bearing is doubled), the life is reduced by one-eighth. Similarly, when the pressure is reduced one-half, the life is increased by eight times.

Battenfeld

Manufacturer*						
Machine model	BE-20 0.78"	BE-40 1.57"	BE-60 2.36"	BE-90 3.54"	BE-120 4.72"	BE-150 5.90"
Screw: Number	One	One	One	One	One	One
Design type	Various design & compression ratios, as required.					
Effective length, inches	- - -	- - -	- - -	- - -	- - -	- - -
L/D ratio, excluding feed opening	20:1	20:1	24:1	24:1	24:1	24:1
Speed range, rpm.	8-88	9-65	8-60	7-54	6-38	6-38
Materials (base & surfacing): Screw	Hard chrome-plated machine steel.					
Cylinder	Nitrided steel.					
Gear reduction type	Spur gearing.					
Torque, foot pounds @ 100 rpm.	- - -	- - -	- - -	- - -	- - -	- - -
Thrust carrier: Type	Ball thrust bearing, roller bearing for radial seating.					
B-10 service life,** (see 1st pg.)##	2,500#	2,500#	2,500#	2,500#	2,500#	2,500#
Extrusion cylinder:						
Number of heating zones	2;2##	3;3##	3;4##	4;4##	5;6##	5;6##
Max. kw. demand on cylinder	3;*	5;*	10;*	20;*	25;*	35
Lubricating system	Oil bath.					
Drive motor, hp.	3	5	10	20	25	100
Extrusion capacity, lbs./hr. (see 1st pg.)	15**	75**	152**	300**	570**	950**
Approx. heat-up time, min., (see 1st pg.)	30	30	60	60	90	90
Heaters: Type	Resistance heater bands.					
Controls	Thermostat.					
Special features (included as standard)	Push-button screw speed change. Extruder & control panel as one integral unit. Dismantling of screw towards the rear of machine.					
Optional features (avail. at extra cost)	Cored screw for fluid heating & cooling. Proportional timers for temperature control.					
Approx. floor space (LxW), feet	3 x 2½	4 x 2½	6½ x 3	10½ x 3-1/3	12½ x 4-2/3	18 x 4-2/3
Approx. delivery time, weeks***	12	12	12	12	12	12

Approximate.
On extruder; on head.
* Kw. on extruder; kw. on head according to requirements.
** Max. output of polyethylene.

Bolling#

Manufacturer*				
Machine model	3½"	6"	8"	10"
Screw: Number	To suit.			
Design type	To suit.			
Effective length, inches	To suit.			
L/D ratio, excluding feed opening	16:1,20:1, 24:1	To suit.		
Speed range, rpm.	12-120	10-90	7-70	5-50
Materials (base & surfacing): Screw	Alloy steel, flame-hardened flights.			
Cylinder	Steel, Xaloy liner.	To suit.		
Gear reduction type	Helical.			
Torque, foot pounds @ 100 rpm.	4,727*	15,756*	23,634*	31,512*
Thrust carrier: Type	Flat roller.			
B-10 service life,** (see 1st pg.)##	39,200	44,200	31,000	46,700
Extrusion cylinder:				
Number of heating zones	3 or 4	4 or 5	To suit	
Max. kw. demand on cylinder	- - -	- - -	- - -	- - -
Lubricating system	Full flood.			
Drive motor, hp.	30-60	100-200	200-300	300-400
Extrusion capacity, lbs./hr. (see 1st pg.)	100-250	500-700	1,500	3,000
Approx. heat-up time, min., (see 1st pg.)	45	60	80	120
Heaters: Type	Liquid, steam.			
Controls	Proportioning.			
Special features (included as standard)	Auxiliary breaker plate. Water-cooled feed screw.			
Optional features (avail. at extra cost)	Information available on request.			
Approx. floor space (LxW), feet	To suit design.			
Approx. delivery time, weeks***	8 - 10	8 - 10	10 - 12	12 - 14

* With 1.5 service factor.

Bolling# (Cont'd.)

Manufacturer*		
Machine model	12"	15"
Screw: Number	To suit.	
Design type	To suit.	
Effective length, inches	To suit.	
L/D ratio, excluding feed opening	To suit.	
Speed range, rpm.	4 - 45	3 - 35
Materials (base & surfacing): Screw	(Same as above)	
Cylinder	To suit.	
Gear reduction type	Helical.	
Torque, foot pounds@ 100 rpm.	47,268*	47,268*
Thrust carrier: Type	Flat roller.	
B-10 service life,** (see 1st pg.)##	22,000	21,000
Extrusion cylinder:		
Number of heating zones	To suit.	
Max. kw. demand on cylinder	- - -	- - -
Lubricating system	Full flood.	
Drive motor, hp.	200-600	200-600
Extrusion capacity, lbs./hr. (see 1st pg.)	4,000	5,000
Approx. heat-up time, min., (see 1st pg.)	120-240	180-360
Heaters: Type	Liquid, steam.	
Controls	Proportioning.	
Special features (included as standard)	(Same as above)	
Optional features (avail. at extra cost)	(Same as above)	
Approx. floor space (LxW), feet	To suit design.	
Approx. delivery time, weeks***	12 - 14	12 - 16

* With 1.5 service factor.

Davis-Standard#

Manufacturer*						
Machine model	Model 20T 2"	Model 25T 2½"	Model 35T 3½"	Model 45T 4½"	Model 60T 6"	Model 80T 8"
Screw: Number	One	One	One	One	One	One
Design type	To customers' specifications.					
Effective length, inches	40;51-7/16	50;61.5	70;86.1	90;111	120;148.2	160;192
L/D ratio, excluding feed opening	20:1;25.8 :1)	20:1;24.6:1		20:1;24.7:1		20:1;24:1
Speed range, rpm.	Up to 200	Up to 200	Up to 150	Up to 130	Up to 100	Up to 75
Materials (base & surfacing): Screw	Alloy steel hardened, polished, and chromed.					
Cylinder	One-piece with Xaloy or Xaloy 306 liner.					
Gear reduction type	Double-reduction helical.					Herring-bone
Torque, foot pounds@ 100 rpm.	1,420*	1,890*	3,930*	6,950*	12,500*	24,700*
Thrust carrier: Type	Cylindrical roller bearing.					
B-10 service life,** (see 1st pg.)##	199,700	156,100	40,400	68,800	33,200	16,900
Extrusion cylinder:						
Number of heating zones	3;4	4;5	4;5	4;5	4;5	4;5
Max. kw. demand on cylinder	15;20	20;25	32;40	40;50	64;80	120;150
Lubricating system	Positive gear-type oil pump.					
Drive motor, hp.	15-25	25-40	50-60	75-100	150-200	200-400
Extrusion capacity, lbs./hr. (see 1st pg.)	120#	200#	400#	600#	1,100#	1,600#
Approx. heat-up time, min., (see 1st pg.)	30	30	30	35	45	60
Heaters: Type	Therm-fin electric tubular.					
Controls	Proportioning controllers for each cylinder zone.					
Special features (included as standard)	Pre-wired control panel. Separate thrust & radial bearings. Water cooled feed section. Stainless-steel hopper with shut-off & level indic. Screw flights extend back beyond feed throat. One-piece cyl. H-d head clamp. Belt drive from motor. Removable feed throat bushing.					
Optional features (avail. at extra cost)	L/D ratios & screw designs to order. Cored or solid screws. Heads to order, with or without electric heating. Valved heads.					
Approx. floor space (LxW), feet	6 x 2**	7 x 2**	9 x 2½**	12 x 3**	15 x 3½**	20 x 4½**
Approx. delivery time, weeks***	6 - 8	6 - 8	6 - 8	6 - 8	10 - 12	15 - 20

* With 1.25 service factor.
# Pounds at 300 psi.
**for 20:1 L/D ratio.

Egan#

Manufacturer*		
Machine model	2	2½
Screw: Number	One	One
Design type	(See continuation)	
Effective length, inches	40	60
L/D ratio, excluding feed opening	20:1; 24:1*	20:1;24:1; 32:1
Speed range, rpm.	(See continuation)	
Materials (base & surfacing): Screw	(See continuation)	
Cylinder	(See continuation)	
Gear reduction type	Herringbone.	
Torque, foot pounds@ 100 rpm.	1,070*	2,265*
Thrust carrier: Type	Roller thrust.	
B-10 service life,** (see 1st pg.)##	200,000	320,000
Extrusion cylinder:		
Number of heating zones	2	4
Max. kw. demand on cylinder	16	28
Lubricating system	Continuous forced feed.	
Drive motor, hp.	10-25	15-50
Extrusion capacity, lbs./hr. (see 1st pg.)	45-90	75-180
Approx. heat-up time, min., (see 1st pg.)	30	30
Heaters: Type	Ceramic or calrod.	
Controls	Proportioning type.	
Special features (included as standard)	(See continuation)	
Optional features (avail. at extra cost)	(See continuation)	
Approx. floor space (LxW), feet	8 x 4	11 x 4
Approx. delivery time, weeks***	2	2

For footnotes: See continuation.

Egan# (Cont'd.)

Manufacturer* / Machine model	3½#	4½#	6#	8#
Screw: Number	One	One	One	One
Design type	As required, depending on application.			
Effective length, inches	84	108	144	192
L/D ratio, excluding feed opening	20:1, 24:1, 32:1			
Speed range, rpm.	As required, depending on application.			
Materials (base & surfacing): Screw	Steel, with flights & surfaces chrome-plated, stellited, nitrided, or pre-hardened.			
Cylinder	One-piece heat-treated alloy steel with Xaloy or Xaloy 306 liner.			
Gear reduction type	Herringbone.			
Torque, foot pounds @ 100 rpm.	7,700**	18,600**	29,800**	61,900**
Thrust carrier: Type	Roller thrust.			
B-10 service life,** (see 1st pg.)##	200,000	200,000	200,000	192,000
Extrusion cylinder: Number of heating zones	4	4 or 5	4 or 5	4 or 5
Max. kw. demand on cylinder	42	72	140	240
Lubricating system	Continuous forced feed.			
Drive motor, hp.	25 - 75	75 - 200	100-300	150-500
Extrusion capacity, lbs./hr. etc. (1st pg.)	120-320	250-600	400-1,000	800-2,000
Approx. heat-up time, min., etc (1st pg.).	30	30	30	30
Heaters: Type	Ceramic or calrod.			
Controls	Proportioning type.			
Special features (included as standard)	Pre-wired control panel. Pre-wired heater bands & thermocouples. Common piping for water & drain lines. Cut-off slide, sight glass & emptying chute on hopper. Breaker plate, head clamp, safety guards.			
Optional features (avail. at extra cost)	Screw-speed indic. Back-press.gage. Melt-temp. indic. assembly. Screw extractors. Heater burn-out lights. Motor-load indicators. Pneu.head clamps. Adaptor with cartridge-type filters. Stepless temp.controller. Timers for preheating cylinders. Var.-pitch flights & torpedo patterns. Direct air cylinder cooling. Willert temp. control system.			
Approx. floor space (LxW), feet	13 x 5	15 x 7	17 x 8	19 x 9
Approx. delivery time, weeks***	4	8	10	12

Heavy-duty, high-pressure designs.
* Over flight length of screw.
**At 1.25 service factor.

Farrel-Birmingham#

Manufacturer* / Machine model	6 x 14*	6*	8½*	10*	12*	15*
Screw: Number	One	One	One	One	One	One
Design type	Melt feed, metering, mixing, etc., to suit requirements.					
Effective length, inches	80	60-144	85-204	60-200	72-240	90-300
L/D ratio, excluding feed opening	16:1	10:1-24:1	10:1-24:1	6:1-20:1	6:1-20:1	6:1-20:1
Speed range, rpm.	To 175	To 150	To 120	To 100	To 100	To 60
Materials (base & surfacing): Screw	Optional, stellite tipped.					
Cylinder	Optional, Xaloy lined.					
Gear reduction type	Single or double reduction, double helical or herringbone.					
Torque, foot pounds @ 100 rpm.	Optional to suit power*.					
Thrust carrier: Type	Single or tandem roller bearing to suit requirements.					
B-10 service life,** (see 1st pg.)##	See footnote**.					
Extrusion cylinder: Number of heating zones	Optional depending on barrel length.					
Max. kw. demand on cylinder	---	---	---	---	---	---
Lubricating system	Flood lubricating by pump.					
Drive motor, hp.	Optional to suit polymer and production rate - to 2,000 hp.					
Extrusion capacity, lbs./hr. etc. (1st pg.)	To 2,500	To 1,200	To 2,500	To 4,000	To 6,000	To 10,000
Approx. heat-up time, min., etc (1st pg.).	30 minutes to four hours, depending on capacity of heaters.					
Heaters: Type	Liquid transfer media or resistance heaters.					
Controls	Automatic, proportioning, manual, etc., as required.					
Special features (included as standard)	Unit is designed to specific requirements of customer.					
Optional features (avail. at extra cost)	---	---	---	---	---	---
Approx. floor space (LxW), feet	Depends on L/D, type of drive (wrap-around, in-line), etc.					
Approx. delivery time, weeks***	20 and up.					

* Usual service factor, 1.50
**Generally, 50,000 hrs. B-10 minimum.

Killion

Manufacturer* / Machine model	K75 (3/4")	K100 (1")	K150 (1½")	K250 (1½")	K350 (3½")
Screw: Number	One	One	One	One	One
Design type	To suit material.				
Effective length, inches	15	20 or 24	30	50	70
L/D ratio, excluding feed opening	20:1	20:1;24:1	20:1	20:1	20:1
Speed range, rpm.	10-60	15-120	12-100	10-80	10-80
Materials (base & surfacing): Screw	Flame-hardened alloy steel.				
Cylinder	Stainless steel.	Stainless steel or Xaloy liner.		Xaloy	Xaloy
Gear reduction type	None	Herringbone type.			
Torque, foot pounds @ 100 rpm.	75	90	---	---	---
Thrust carrier: Type	Ball bearing.		Roller thrust bearing.		
B-10 service life,** (see 1st pg.)##	10,000	20,000	30,000	50,000	70,000
Extrusion cylinder: Number of heating zones	2	2 or 3	3	3	3 or 4
Max. kw. demand on cylinder	1.5	2½	18	24	30
Lubricating system	None	Splash from housing.		Splash or circulating.	
Drive motor, hp.	1/2	1	7	20	30 or 40
Extrusion capacity, lbs./hr.	6	18	60	150	250
Approx. heat-up time, minutes	15	20	30	30	45
Heaters: Type	Electric resistance type.				
Controls	On-off capillary type.	Optional	Proportioning type.		
Special features (included as standard)	---	---	---	---	---
Optional features (avail. at extra cost)	---	Vented barrels, valves, pressure gages.			
Approx. floor space (LxW), feet	2½ x 1	2½ x 1½	5 x 1½	7-1/3 x 2-1/6	9½ x 3-1/3
Approx. delivery time, weeks***	2	2	6	8	8

Luigi Bandera

Manufacturer* / Machine model	TRS 30 to TRS 200 (1-1/8" to 7-7/8")
Screw: Number	One
Design type	For all thermoplastics
Effective length, inches	---
L/D ratio, excluding feed opening	17:1; 20:1
Speed range, rpm.	6 to 71
Materials (base & surfacing): Screw	Hardened & ground nickel-chrome alloy.
Cylinder	" "
Gear reduction type	Herringbone
Torque, foot pounds @ 100 rpm.	---
Thrust carrier: Type	Spherical roller.
B-10 service life,** (see 1st pg.)##	---
Extrusion cylinder: Number of heating zones	2 to 3
Max. kw. demand on cylinder	---
Lubricating system	Oil bath
Drive motor, hp.	2 to 150
Extrusion capacity, lbs./hr.	15 to 1,760
Approx. heat-up time, minutes	20 to 60
Heaters: Type	Mica insulation type.
Controls	Stabilmatic (proportioning type.)
Special features (included as standard)	6 to 8 gear speeds, prewired assembly.
Optional features (avail. at extra cost)	Venting & devolatilizing.
Approx. floor space (LxW), feet	---
Approx. delivery time, weeks***	In stock in N. Y.

M P M

Manufacturer* / Machine model	1½"	2½"	3½"
Screw: Number	One	One	One
Design type	Four standard design types available; others to customers' orders.		
Effective length, inches	30	50	70
L/D ratio, excluding feed opening	20:1	20:1	20:1
Speed range, rpm.	16-113	10-200	20-150
Materials (base & surfacing): Screw	4140 steel, flame-hardened lands, chrome-plated.		
Cylinder	Xaloy or Xaloy 306 liner.		
Gear reduction type	Silent chain.	Herringbone type.	
Torque, foot pounds @ 100 rpm.	395	2,217	3,392
Thrust carrier: Type	Roller thrust.		
B-10 service life,** (see 1st pg.)##	60,000	50,000	180,000
Extrusion cylinder: Number of heating zones	2	4	4
Max. kw. demand on cylinder	6.2	13.2	26.4
Lubricating system	Submerged dip.		
Drive motor, hp.	5	20-25	30-40
Extrusion capacity, lbs./hr.	25-35	200	385
Approx. heat-up time, minutes	35-40	35-40	35-40
Heaters: Type	Cast-in, band, or induction heaters.		
Controls	Proportioning type.		
Special features (included as standard)	Tachometers. Ammeters. Melt thermocouples. Pressure gages.		
Optional features (avail. at extra cost)	Hydraulic press.system for controlling & valving press. in extruder by moving screw.		
Approx. floor space (LxW), feet	4 x 7	4 x 10	4 x 12
Approx. delivery time, weeks***	6 - 8	8	8

	MPM (Cont'd.)			NRM					Olympia
Manufacturer*									
Machine model	4½"	6"	8"	Model 55 (1-1/2")	Vanguard II (2-1/2")	Vanguard III (3-1/2")	Pacemaker (3-1/2")	Pacemaker (4-1/2")	Pacemaker (6")	1½
Screw: Number	One	One	One	Single	Single	Single	Single	Single	Single	One
Design type	(See preceding page)			Six standard designs.						(See below)
Effective length, inches	90	120	160	30"	50"	69½"	69½"	89-1/16"	118-3/4"	33
L/D ratio, excluding feed opening	20:1	20:1	20:1	20:1	20:1, 24:1					20:1
Speed range, rpm.	20-110	6-76	8-72	12-80	5-180	5-160	10-130	10-120	10-100	25-175
Materials (base & surfacing): Screw	(See preceding page)			Chrome-plated alloy steel, surface-hardened flight lands.						(See below)
Cylinder	(" " ")			One-piece steel with cast-in Xaloy 306 liner.						(See below)
Gear reduction type	Herringbone type.			Roller chain.	Worm	Worm	Helical	Helical	Helical	Shaft mounted reducer.
Torque, foot pounds @100 rpm.	8,967	16,583	23,756	- - -	- - -	- - -	- - -	- - -	- - -	750
Thrust carrier: Type	Roller thrust.			Ball	Roller	Roller	Roller	Roller	Roller	(See below)
B-10 service life,** (see 1st pg.)##	121,000	110,000	62,500	500 min.# 2,500 ave.	212,500 std.	61,000 std.	61,000 std.**	75,000 std.***	55,000 std.##	550,000*
Extrusion cylinder:										
Number of heating zones	5	5	6	2	4	4	4	5	5	2
Max. kw. demand on cylinder	42.5	62.0	125.0	5.1	13.75	25.8	25.8	38.5	42	8
Lubricating system	Submerged dip.			Automatic.						(See below)
Drive motor, hp.	75-100	125-150	200-300	5	10-40	25-40	25-75	50-125	100-300	5-7½
Extrusion capacity, lbs./hr.	600	900	1,600	30-42*	200*	400*	400*	600*	1,000*	60-75
Approx. heat-up time, minutes	35-40	35-40	35-40	30	30	30	30	30	30	30
Heaters: Type	(See preceding page)			Cast-in.	Induction or cast-in resistance.					(See below)
Controls	Proportioning type.			Proportioning type pyrometers; 3-pos. on induction machines.						Proportioning
Special features (included as standard)	(See preceding page)			Prewired fabricated steel control cabinet. Quick-changing die adapter gate. Automatic cooling, air or liquid.						(See below)
Optional features (avail. at extra cost)	(See preceding page)			Bal. heat control	Over-temp. alarms, vacuum feed. Handi-clamp front end.					(See below)
					2½ x 5 feed opening	3½ x 7 feed opening		4½ x 9 feed opening	6 x 12 feed opening	
Approx. floor space (L x W), feet	5 x 15	5 x 18	6 x 22	4-1/2 x 1-2/3###	6x2###	8x2###	9 x 3 ###	11x3###	14x3½###	5 x 2½
Approx. delivery time, weeks***	10	12	16	4	6	6	6	8	10	4 - 6

* Nominal ** Also available with double oversize thrust bearings to give B-10 service life of 405,000 hrs.
*** Also available with double oversize thrust bearings to give B-10 service life of 363,000 hrs.
# At 18,900 psi. & 40 rpm.
Also available with double oversize thrust bearings to give B-10 service life of 484,000 hrs.
Not including electrical control cabinet.

	Olympia (Cont'd.)				Prodex					
Manufacturer*										
Machine model	2½	3½	4½	6	1-3/4;2"	2½"	3½"	4½"	6"	8"; 10"
Screw: Number	One	One	One	One	One	One	One	One	One	One
Design type	Various designs available to suit application.				Metering.					
Effective length, inches	53	70	90	126	35-52; 40-60	50-75	70-105	90-135	120-180	160-240; 200-300
L/D ratio, excluding feed opening	20:1	20:1	20:1	20:1	20:1, 24:1, 30:1					
Speed range, rpm.	20-130	20-110	10-85	0-75	35-145	5-225	5-140	5-120	5-100	5-100; 3-80
Materials (base and surfacing): Screw	Stellite-tipped or flame-hardened flights. Chrome-plated.				Stellite-tipped 4140 steel.					
Cylinder	One-piece steel with integral Xaloy liner.				Xaloy.					
Gear reduction type	Herringbone gear type.				Helical	Herringbone.				
Torque, foot pounds @100 rpm.	1,130 - 2,216	2,216 - 3,400	5,160 - 6,390	6,350 - 8,570	315;525*	1,050*	3,150*	6,300*	11,000*	22,000; 39,000*
Thrust carrier: Type	Spherical roller.				Spherical roller.					
B-10 service life,** (see 1st pg.)##	350,000*	175,000*	55,000**	25,000***	100M;68M	102,000	88,000	50,000	68,000	72M; 70M
Extrusion cylinder:										
Number of heating zones	3	4	4	5	2;2	3-4	3-4	3-4	5-6	6-7; 7-8
Max. kw. demand on cylinder	15	30	45	65	10;12	14-20	25-35	35-50	68-90	90-125; 160-200
Lubricating system	Force feed to thrust assembly.				Recirculating.	Gear pump.				
Drive motor, hp.	15-30	30-50	50-100	100-150	7½;10-15	20-40	40-75	75-150	150-250	300-500; 500-800
Extrusion capacity, lbs./hr.	90-200	400	600	1,100	50-150	250	500	700	1,250	2,500; 4,000
Approx. heat-up time, minutes	40	40	40	40	30	30	35	35	35	45
Heaters: Type	Choice of mica or Starflex.				Calrod.					
Controls	Proportioning.				Electronic.					
Special features (included as standard)	Prewired control panel, all elec. & plumbing complete, hopper shut-off and level indic., quick-opening clamp, safety guard.				Valving pressure gages. Stock temperature thermocouple. Change gear reducer.					
Optional features (avail. at extra cost)	Valving, pressure gages, vented and two-stage extrusion.				Screen changers. Pressure transducers.					
Approx. floor space (LxW), feet	8 x 5	10 x 5	12 x 5	16 x 5	5 x 21; 6 x 2	9 x 2	11 x 3	15 x 3	20 x 5	25 x 8; 32 x 9
Approx. delivery time, weeks***	4 - 6	6 - 8	8 - 10	12 - 14	- - -	- - -	- - -	- - -	- - -	- - -

* Also available with oversize thrust bearings to give B-10 service life of 300,000 hrs.
** " 170,000 hrs.
*** " 32,500 hrs.

* With 1.5 Service Factor.

	Reifenhauser	Royle					Sterling#	
Manufacturer*								
Machine model	1½, 1-3/4, 2½, 3½, 4½, 6	#2 (2½")	#4 (3½")	#2A (4½")	#3A (6")	#4A (8½")	#5A (10")	1½"	2"
Screw: Number	One	One	One	One	One	One	One	One	One
Design type	To suit material.	Metering						(See below)	
Effective length, inches	- - -	60	84	90	120	127½	140	35½	42
L/D ratio, excluding feed opening	20:1 - 30:1	24:1	24:1	20:1	20:1	15:1	14:1	20:1*	20:1*
Speed range, rpm.	200 max.	20-200	18-180	18-180	18-180	10-100	10-100	0-150	0-150
Materials (base & surfacing): Screw	Nitraloy	Stainless steel, hard-surfaced weld.						(See below)	
Cylinder	Xaloy 306	Steel with removable Xaloy liner.						Xaloy.	
Gear reduction type	Hardened & ground helical.	Worm	Worm	Opposed helical.				Herringbone gear reducer.	
Torque, foot pounds @100 rpm.	- - -	2,890	5,510	9,820	17,750	25,200	34,600	- - -	- - -
Thrust carriers: Type	Spherical roller.	Cylindrical roller bearings.						(See below)	
B-10 service life,** (see 1st pg.)##	176,000-60,000 resp.	163,500	150,000	120,000	63,000	50,000	40,000	#	
Extrusion cylinder:									
Number of heating zones	3 - 6	4	4	3	3	3	3	2	3
Max. kw. demand on cylinder	10 - 40	27	51	54	85	108	132	7½	10.8
Lubricating system	Forced automatic.	Self-enclosed gravity flow with positive feed.						(See below)	
Drive motor, hp.	3-150 resp.	40	75	125	200	300	400	5 - 10	10 - 15
Extrusion capacity, lb./hr.	- - -	200	400	700	1,150	1,800	2,500	55	100
Approx. heat-up time, minutes	- - -	20	20	30	30	30	30	25	25
Heaters: Type	Resistance band.	Tubular resistance heaters.						(See below)	
Controls	Proportioning.	Proportioning.						(See below)	
Special features (included as standard)	In-line motor.	Safety head bolts. Common housing for gear & thrust carrier. Dual voltage control. Hi-velocity evaporating cooling. Spirod radiant heating. Adjustable pressure valve.						(See below)	
Optional features (avail. at extra cost)	Floating screw pressure control. MT gear reducer.	Vented and 2-stage extrusion. Controlled-velocity flow. Other screw sizes, L/D ratios, and drive sizes on request.						(See below)	
Approx. floor space (LxW), feet	- - -	7 x 2	8½ x 2½	9 x 4	13 x 4½	14 x 5	16 x 6	3½ x 3	5 x 4½
Approx. delivery time, weeks***	10 - 14	- - -	- - -	- - -	- - -	- - -	- - -	4 - 5	4 - 6

(See footnote below)

	Sterling# (Cont'd.)				Stokes		Waldron-Hartig			
Manufacturer*										
Machine model	2½"	3½"	4½"	6"	850 (2½")	851 (3½")	15120 2½"	25120 3½"	35120 4½"	45120 4½"
Screw: Number	One	One	One	One	One	One	One	One	One	One
Design type	Metering & other designs to meet applications.				Metering.		Various design types & compr. ratios, as req'd.			
Effective length, inches	52½	73½	99½	126	- - -	- - -	30,36	50,59	70,84	90,108
L/D ratio, excluding feed opening	20:1*	20:1*	20:1	20:1	20:1	20:1	20:1*, 24:1	20:1*, 24:1	20:1, 24:1	
Speed range, rpm.	0-125	0-125	0-100	0-100	15-90	15-90	25-180*	23-140*	5-120*	5-105*
Materials (base & surfacing): Screw	Chrome-molybdenum steel, flame-hardened.**				Special alloy, flame-treated lands.		Heat-treated alloy steel with flame-hardened flights.			
Cylinder	Xaloy.				Xaloy.		Alloy steel with Xaloy 306 integral lining.			
Gear reduction type	Herringbone gear reducer.				Herringbone.		Herringbone gear type.			
Torque, foot pounds @ 100 rpm.	- - -	- - -	- - -	- - -	- - -	- - -	904.0#	1,785#	4,360#	6,930#
Thrust carrier: Type	Self-aligning spherical roller thrust bearing.				- - -	- - -	Cylindrical roller.			
B-10 service life**(see 1st pg.)##	#	#	#	#	- - -	- - -	500,000**	65,000**	36,000**	17,000**
Extrusion cylinder:										
Number of heating zones	3	3	4	4	3	3	2	3	3	4
Max. kw. demand on cylinder	18	26.4	48	72	18	18	9.0	15.3	27.6	46.5
Lubricating system	Forced feed. Closed system for reducer & thrust bearing.				Splash type.		Recirculating oil bath type.			
Drive motor, hp.	15 - 25	30 - 40	75 - 100	150-200	10 - 20	25 - 40	7½ - 20	20 - 40	40-75	60-125
Extrusion capacity, lbs./hr.	150	350	600	1,000	100	200	50-80	200-320	375-600	625-1,000
Approx. heat-up time, minutes	25	30	35	35	30	30	25	30	30	30
Heaters: Type	S.S. mica band, cast-in alum., thermostrip.				Elec. resistance.		Cast aluminum.			
Controls	Proportioning or saturable core reactor controls.				Proportioning.		Proportioning pyrometer type.			
Special features (included as standard)	Water/steam barrel cooling or air cooling. Clamp-type closure or swing bolts. Floating thrust bearing design.				Six-instrument control panel. Extra-large feed throat.		Packing gland at hopper section. Quick-opening 3-piece head clamp. Aux. supply hopper. Water-cooled feed screw.			
Optional features (avail. at extra cost)	Pressure gages. Melt thermocouples. Tachometers. Vented extruders. Valving mechanisms.				Blowers. Water cooling of screws.		Valves. Vent. Air mist or air blower cooling. Auto. cooling control. Melt thermocouple.			
Approx. floor space (LxW), feet	5½ x 4½	7 x 5	10 x 5	14 x 6	12 x 3	12 x 6	4½ x 4½	5½ x 5	8 x 6	10 x 7
Approx. delivery time, weeks***	4 - 8	6 - 8	6 - 8	10 - 12	6	6	- - -	- - -	- - -	- - -

Several thrust bearing assemblies available for each extruder size with minimum life of 16,000 hrs. and average life of 80,000 hrs.

* Also available in 24:1 & 30:1 ratios.

** Also available in stainless steel.

* Other screw speeds available.

** Tandem bearings available for 10,000 psi. operation.

At 1.25 service factor.

Manufacturer*	Waldron-Hartig (Cont'd.)		Wayne	Welding Engineers					
Machine model	60T20 6"	80T20 8"	3/4" Lab Table Model	2" Special	2" 2052VI	2.8" 2852 VI	3½" H3500 DX	4½" HH4552 VI	6" 6052 HV2
Screw: Number	One	One	One	Two	Two	Two	Two	Two	Two
Design type	(Preceding page)		Any specified.	Full-flighted, metering, or special types.					
Effective length, inches	120,144	160,192	15-1/8	30 - 84	50	70	147	112½	150
L/D ratio, excluding feed opening	20:1, 24:1		20:1	25-42	25	25	20	25	25
Speed range, rpm.	5-90*	5-66*	10-112	150 max.	150 max.	150 max.	150 max.	150 max.	150 max.
Materials (base & surfacing): Screw	(See Preceding pg.)		Alloy steel.	Stellited stainless steel.					
Cylinder	(" " ")		Nitrided steel.	Xaloy 306.					
Gear reduction type	Herringbone gear type		Worm gear.	Spur gear.		Planetary.			
Torque, foot pounds @ 100 rpm.	11,550#	30,400#	300	- - -	- - -	- - -	- - -	- - -	- - -
Thrust carrier: Type	Cylindrical roller.		Ball bearing.	Ball Bearing.		Spherical roller bearing.			
B-10 service life,** (see 1st pg.)##	17,900**	16,000**	- - -	80,000##	80,000##	100,000##	120,000##	160,000###	160,000###
Extrusion cylinder:									
Number of heating zones	4	5	- - -	5 - 8	6	6	5	6	6
Max. kw. demand on cylinder	76.5	100	1.6	20	14	28	56	56	152
Lubricating system	(See preceding pg.)		Splash	Splash type.		Forced lubrication.			
Drive motor, hp.	125-200	250-400	1/2 or 3/4	10	10	25	100	150	300
Extrusion capacity, lbs./hr. etc.	1000-1600	2000-3200	7	125*	125*	300*	1,000*	1,000*	2,000*
Approx. heat-up time, minutes	35	40	20	45	45	60	75	75	90
Heaters: Type	Cast aluminum.		Mica band.	Hot oil circulation.					
Controls	(See preceding pg.)		Powerstats.	Thermostat.					
Special features (included as standard)	(See preceding pg.)		- - -	Compounder-Extractor-Extruder.					
				Lab.test unit. Can be assembled for various barrel lengths & types.	Small vent lab. or production unit.	Small vent units.		Large vent unit. Adjustable pressure treatment.	
Optional features (avail. at extra cost)	(See preceding pg.)		- - -	All types of variable-speed drives, explosion-proof construction, quick-opening dies, screening heads, strand dies, pelletizing systems, special dies and other features to meet individual requirements.					
Approx. floor space (LxW), feet	13½ x 7½	18½ x 7	- - -	7 x 2	7 x 2	8 x 3	14 x 4	14 x 4	20 x 5
Approx. delivery time, weeks ***	- - -	- - -	3 - 4	24	20	24	30	30	36

Footnotes: (See preceding pg.)

* When processing raw crumb feed of low-pressure polyethylene.
Service life, hrs., at 100 rpm. and 2,000 psi.
Service life, hrs., at 100 rpm. and 4,000 psi.

Manufacturer*	Werner & Pfleiderer#				Windsor			
Machine model	ZSK 83/1100 3-1/4"	ZSK 83/1450 3-1/4"	ZSK 120/1500 4-3/4"	PK 100/N 12"/4"/3/4"	3½"	4½"	R.C. 100	R.C. 20
Screw: Number	Two	Two	Two	Three	One	One	Two	Two
Design type	Interchangeable screw sleeves and kneading disks.			Twin feeders, milling cone & metering.	To meet customer's applications.			
Effective length, inches	46	61	60	- - -	- - -	- - -	- - -	- - -
L/D ratio, excluding feed opening	14:1	19:1	12.5:1	- - -	20:1	20:1	- - -	- - -
Speed range, rpm.	160 max.	160 max.	150 max.	*	10 - 90	10 - 80	6 - 18	12 - 45
Materials (base & surfacing): Screw	Nitrided steel.			- - -	Selected alloy steel.			
Cylinder	Nitrided steel.			- - -	Nitrided steel.			
Gear reduction type	Herringbone spur gear.			Spur gear and chain.	- - -	- - -	Spur gears.	
Torque, foot pounds @ 100 rpm.	- - -	- - -	- - -	- - -	Controlled torque.		- - -	- - -
Thrust carrier: Type	Roller bearings.				Designed to withstand 75 tons.		- - -	- - -
B-10 service life,** (see 1st pg.)##	60,000#	60,000	80,000#	80,000#	- - -	- - -	- - -	- - -
Extrusion cylinder:								
Number of heating zones	3	4	4	1	4	5	3	6
Max. kw. demand on cylinder	30 - 50	40 - 64	50 - 68	6	24	35	7 - 8	25
Lubricating system	Forced lubrication.				Flood lubrication.		Forced lubrication by gear pump.	
Drive motor, hp.	80	80	200	30	40	50	10	30
Extrusion capacity, lbs./hr.	600-800	600-800	1500-1800	500-700**	250*	400*	100*	150-200*
Approx. heat-up time, minutes	100## min.	100##	100##	45##	- - -	- - -	- - -	- - -
Heaters: Type	Cast-in aluminum (brass) or jacketed.			Cast-in and jacketed.	Induction.			
Controls	Proportioning.				Controlling pyrometers.			
Special features (included as standard)	Screw-shaft cooling; torque-overload interlocks; screw & barrel surfaces self-cleaning; venting on enforced decompression sections.			Venting.	Hydr. variable drive. Easily detachable die adaptor. Controlled cooling on barrels.		Splined screw design for easy removal.	Auto.adjustable. Volumetric feed.
Optional features (avail. at extra cost)	Hot pelletizers. Stranding dies. Face-cutting unit. Various drives. Explosion-proof construction. Hydr. screen pack changer. Pellet coolers and dryers.			Screw pull-off device. Mounting carriage.	- - -	- - -	- - -	- - -
Approx. floor space (LxW), feet	10 x 3	11 x 3	14 x 4	10 x 4	12 x 2-3/4	14 x 3	7 x 3	- - -
Approx. delivery time, weeks ***	30	30	30	20	- - -	- - -	- - -	- - -

* 32 rpm. for milling cone.
** For flexible PVC only.
Minimum
Due to screw design, optimum performance is at pressures below 1,000 psi.
* Nominal output.

PT's Comparative Data on 1961 Blow-Molding Machines.

(Based on data submitted by the machine manufacturers.)

Manufacturer*	Acme		Atlas		Auto-Blow #					
Machine model	1216C	1824C	Mark I	Mark X	155-B-7	150-B-14	450B	Meter Heater 167-B	Meter Heater 169-B	Meter Heater 209-B
Type of preliminary operation	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion	Extrusion
Method of operation	Automatic →		Automatic →		Automatic →					
Number of molds	2 or 4	2 or 4	2 - 4	2 - 8	4	2	2	4	2	4
Number of pieces per cycle	2 or 4	2 or 4	2 - 4	2 - 8	4	2	2	4	2	4
Hopper capacity, lbs.	- - -	- - -	- - -	- - -	50#	100#	100#	100#	100#	100#
Platen area, WxD, inches	12 x 16	18 x 24	18 x 12	32 x 24	15 x 12*	21 x 15*	30 x 26*	11 x 16	11 x 16	15 x 20
Clamp tonnage or mold closing force, tons.	6 or 9	20	3-12 adj.	26	5	9	25	10	10	12
Daylight opening, inches	10 - 20	12 - 24	20	36	14½	24	34	13	18	18
Platen stroke, inches	6	6	4½	7½	7½	14½	16	7	9	9
Max. size of part moldable:										
Diameter, inches or WxD	8	10	8½	14½	6	14	15½	5	7	7
Length, inches	36	36	36	36	36	45	60	18	18	24
Projected cross-section area, sq. in.	120	300	156	520	330	596	1,663	- - -	- - -	- - -
Dry cycle time (without cooling), min.	- - -	- - -	0.025	0.033	0.012	0.024	0.026	0.012	0.012	0.012
Output, lbs./hr., of finished parts (in polyethylene)	150	275	- - -	- - -	100**	190**	375**	225	150	150
Recommended preliminary machine size (also include L/D ratio for extruder, if used)	3-½", 20:1 or 24:1	4", 20:1 or 24:1	3½" max., 20:1	4½" max., 20:1	2½",21:1	3½",21:1	4½",21:1	- - -	- - -	- - -
Tie bars: Number	2 or 3	3 or 4	4	8	2	2	4	2	2	2
Size, inches	1-3/4	2	1½	1½	1-3/4#	2-1/8#	2#	2	2	2½
Machine dimensions (SxWxH), feet	8x3x8	10x7x9	8x3x 4-2/3	10x3-1/3 x5-1/2	10x2.5x 8##	11x2.5x 8##	12x3x9##	15x15x 4-3/4	20x20x 4-3/4	25 x 25 x -
Approx. floor space required, sq. ft.	40 plus extruder	70 plus extruder	6 x 8	10 x 6	110	160	270	15 x 15	20 x 20	25 x 25
Aporox. shipping weight, lbs.	- - -	- - -	5,200	8,500	10,000###	11,000###	16,000###	9,000###	9,000###	11,000###
Special features	Auto.accumulator metering →		Ball-bearing platens. All-hydraulic operation, self-contained. Hydr.system designed for fast accel.of platens and decel.		Cross-heads adapt. to use with 2,3, or 4 die heads. Air cyl. strippers. Positive hydr. clamping. Uniform flow, self-cleaning heads →		Used with accumul. for uninterrupted extrusion.	Accurately metered & parison speed controlled by accumulator. →		
Optional features avail. at extra cost	Auto. strippers →		Accumulators, cut-off, retract.mandrels, dual heads. →		1-15 lb. accumulators available. Larger daylights & strokes. Greater clamping press. Die heads with individ.flow controls →			- - -	- - -	- - -
Approx. delivery time, weeks	4 - 6	4 - 6	6 - 8	8 - 10	8	8	8	7 - 10	7 - 10	7 - 10

* Clear of tie bars.
** Larger or smaller capacity extruders optional.
*** With extruder.
# Rides on gibbed ways.
Press and cross-head only.
Complete blow-molding unit.

* Complete company names and addresses are as follows:

Acme Machinery & Mfg. Co., 500 Saw Mill River Rd., Yonkers, N. Y.
for Trico Mfg. Co.
Atlas Molding Machine Corp., Box 58, 257-259 Hackensack St., East Rutherford, N. J.
Auto-Blow Corporation, 401 Bishop Avenue, Bridgeport 10, Conn.
Battenfeld Corporation of America, 959 West Grace St., Chicago 13, Ill.
Johann Fisher Co., Germany, units are sold in U.S.A. by Barclay Industries, Inc., 11 West 42 Street, New York 36, N. Y.
Kautex machines made by Kautex-Werke, West Germany, and by Kautex Machines, Inc., Linden, N.J., are sold in the U.S.A. by The Rainville Co., Inc., 839 Stewart Avenue, Garden City, N. Y.

Has more machines in addition to tabulated models.

Leadpak, Inc., 924 Fifth Avenue, New York 1, N. Y.
Modern Plastic Machinery Corp., 64 Lakeview Ave., Clifton, N. J.
Moslo Machinery Company, 2443 Prospect Ave., Cleveland 15, Ohio
Prodex Corp., King George Post Road, Fords, N. J.
Producto Machine Co., 990 Housatonic Ave., Bridgeport 1, Conn.
Quality Machine Co., 1840 Givan Avenue, Bronx, N. Y.
F. J. Stokes Corp., 5500 Tabor Road, Philadelphia 20, Pa.
Waldron-Hartig Division, Midland-Ross Corp., P.O. Box 531, Westfield, N. J.

	Battenfeld						Fischer #			
Manufacturer*										
Machine model	BBA 25	BBA 25E	BBBA 3	BBBA 10	BBBB 10	BBBB 50	BM 50/5000 LTR	BM 5/15 LTR	BM 10/40 LTR	BM 30/90 LTR
Type of preliminary operation, etc.	Injection	Extrusion.					Extrusion.			
Method of operation	Automatic,	Semi-auto.,	and Manual.				Auto.	Auto.	Semi-auto.,	or auto.
Number of molds	One	One	One	One	One	One	1 or 2	1 or 2	1 or 2	1 or 2
Number of pieces per cycle	Multiforming	possible.					1 or 2	1 or 2	1 or 2	1 or 2
Hopper capacity, lbs.	50#	50#	50#	50#	50#	50#	55	55	100	100
Platen area, W x D, inches	16.9 x 9.8		16.5x12.7	15.4 x 19.3		26 x 23.6	16.6x11.8	23.6x15.7	29.5x19.7	29.5x31.3
Clamp tonnage or mold closing force, tons.	10	10	15	30	30	90	4.5	9	17	33
Daylight opening, inches	7	7	9.8	11.8	11.8	17.8	14	15.4	24	32.7
Platen stroke, inches	5.9	5.9	7.8	10	10	15.6	6.7	7.5	11.8	17.7
Max. size of part moldable:										
Diameter, inches or W x D	4	4	6	8	8	14	5.2	5.7	9.5	11.8
Length, inches	6	6	9.8	12.5	18	20	11	15	18.5	30
Projected cross-section area, sq. in.	24	24	72	128	128	280	88	180	330	520
Dry cycle time (without cooling), minutes	11	20	8	7	6	4	0.017	0.017	0.03	0.05
Output, lbs./hr., of finished parts (in polyethylene)	16	26	44	88	88	280	120	120	240	240
Recommended preliminary machine size, etc.	7.3*	1.8,* 24:1	1.6,* 22:1	2.4,* 22:1	2.4,* 20:1	3.5,* 20:1	2½, 15:1	2½, 20:1	3½, 20:1	3½, 20:1
Tie bars: Number	2	2	4	4	4	4	4	4	4	4
Size, inches	1.78 dia.	1.78 dia.	1.57 dia.	1.97 dia.	1.97 dia.	2.56 dia.	2.5	3	3.5	4
Machine dimensions (LxWxH), feet	5 x 4.5 x 8.3		5.8x4x 6.1	8.9x4.15x 8.05	8.9x5.6x 8.4	10.5x6.7x 9	8.3x10.5x 8.4	14.8x10.8x 9.7	15.5x14.4x 11.6	16.8x14.8x 13.7
Approx. floor space required, sq. ft.	22.5	22.5	23	37	50	70	120	200	250	300
Approx. shipping weight, lbs.	4,400	4,600	8,400	12,350	14,400	32,000	5,200	8,800	13,000	17,700
Special features	Plast. with injection cyl.	Accumulator head.	Scissor tube transport device.		Accumulator head only, twin head possible.		Machines deliver finished parts that do not require reaming or other secondary operations. *Can be used in combination with single or double extrusion heads.* Provide for continuous extrusion.			
								Can be equipped with accumulators.		
Optional features avail. at extra cost	Variety of screw designs, accumulator extrusion head & larger screw.						Can be equipped with non-corrosive components enabling their use with corrosive materials. Can be equipped with single- or multi-cavity molds. Heads & screws for working all thermoplastics.			
Approx. delivery time, weeks	12 - 20	12 - 20	12 - 20	12 - 20	12 - 20	12 - 20	8 - 12	8 - 12	12 - 16	12 - 16

* Volume/shot, cubic inches.

	Fischer # (Cont'd.)		Kautex						Leedpak
Manufacturer*									
Machine model	BM 50/350 LTR	BM 5-350L	V-8-Z	H-10	V-8	V-18	H-110	H-260	Allpak
Type of preliminary operation, etc.	Extrusion.		Extrusion.						Forming*
Method of operation	Semi-auto.	Auto.	Auto.	Semi-auto.	Auto.	Auto.	Semi-auto.	Semi-auto.	Automatic.
Number of molds	1	1	Up to 3.				1	1	2 - 10
Number of pieces per cycle	1	1	Up to 3.				1	1	2 - 10
Hopper capacity, lbs.	100	55	100	100	100	100	100	100	(Not applicable)
Platen area, W x D, inches	47 x 47	- - -	11-3/4 x 13-3/4	10-1/2 x 15-3/4	11-3/4 x 13-3/4	13-1/2 x 23-1/2	22-3/4 x 31-1/2	27 x 49	11 x 22
Clamp tonnage or mold closing force, tons.	60	3/4	1.87	1.32	1.87	2.96	13.78	27.56	- - -
Daylight opening, inches	55.2	- - -	15-3/4	18	15-3/4	17-3/4	35	47-1/4	- - -
Platen stroke, inches	27.6	- - -	10-1/2	13	10-1/2	11-1/2	22-1/2	26-1/4	- - -
Max. size of part moldable:									
Diameter, inches or W x D	22	2.4	6-1/4	8	6-1/4	7	15	19-3/4	6
Length, inches	38	4.3	11-3/4	11-3/4	11-3/4	19-3/4	27-1/2	39-1/2	- - -
Projected cross-section area, sq. in.	1,020	18	73-1/2	94	73-1/2	140	420	800	300
Dry cycle time (without cooling), min.	0.10	0.03	3.3	8.3	0.033	0.8	4.8	7.2	0.33
Output, lbs./hr., of finished parts (in polyethylene)	500	22	176	66	88	265	265	265	- - -
Recommended preliminary machine size, etc.	4½", 20:1	1¼",15:1	Kautex Twin 340 special extruder.	Kautex 340 extruder, 18:1		Kautex 360 extruder, 20:1			(Not applicable)
Tie bars: Number	4	2	2	2	2	2	2	4	None
Size, inches	6	1¼	- - -	- - -	- - -	- - -	- - -	- - -	None
Machine dimensions (L x W x H), feet	20x15.11x 14	- - -	8-1/3 x 12⅓x8-2/3	8x4½x7	8-1/3x12½ x 8-2/3	11-1/3x 10½x10-2/3	13½x13½ x 10-2/3	14x15½ x 11	10 x 3 x 4
Approx. floor space required, sq. ft.	400	- - -	105	36	105	125	185	210	100
Approx. shipping weight, lbs.	26,000	2,000	10,000	3,308	7,277	15,215	17,641	22,051	- - -
Special features	(Same as above.) Except sentence in quotes (See above)		Neck-calibrating patent license included.			With accumulator.			Special laminates can be blow-formed.
Optional features avail. at extra cost			Tubular or sheeting dies.	- - -	- - -	- - -	- - -	- - -	- - -
Approximate delivery time, weeks	16	- - -	12 - 16	6	In stock	8	24	24	20

* From sheet material.

Manufacturer*	MPM					Moslo	Prodex			
Machine model	V-21	V-21-4	V-21-8	E-21	L-30	1246	96	149	2424	3826
Type of preliminary operation, etc.	Extrusion.					Injection	Extrusion.			
Method of operation	Automatic.					Automatic	Automatic.			
Number of molds	2	4	8	2	1,2,4	1 - 8	1 - 4	1 - 4	1 - 2	1 - 2
Number of pieces per cycle	2	4	8	2	1,2,4	Varies with product.	1 - 8	1 - 8	1 - 2	1 - 2
Hopper capacity, lbs.	60 - 180	60 - 180	60 - 180	60 - 180	20	75	150	150	250	250
Platen area, W x D, inches	- - -	- - -	- - -	- - -	- - -	10.8 x 14 x 5	9 x 6	14 x 9	24 x 24	38 x 26
Clamp tonnage or mold closing force, tons	2	12.5	12.5	12.5	0.8	90	5	8	18	39
Daylight opening, inches	28	28	28	28	12	6	12	17	41	60
Platen stroke, inches	14	14	14	14	4	6	8	10	18	33
Max. size of part moldable:										
Diameter, inches or W x D	12	12	12	12	3½	5-3/4	7	10	18	30
Length, inches	36	36	36	36	10	10	11	18	28	40
Projected cross-section area, sq. in.	40*	225*	225*	225*	15*	27	54	130	400	800
Dry cycle time (without cooling), min.	3,600	3,600	3,600	3,600	3,600	0.10	0.033	0.04	0.016	0.016
Output, lbs./hr., of finished parts (in polyethylene)	220	220	220	190	12	625	30 - 80	60 - 160	75 - 200	80 - 300
Recommended preliminary machine size, etc.	3½",20:1	3½",20:1	3½",20:1	2½",20:1	1",20:1	4-6 oz.	1-3/4;20:1	2½;20:1	1-3/4;20:1	2";20:1
Tie bars: Number	4	4	4	4	2	None	None	None	2	4
Size, inches	1¾	1¾	1¾	1¾	1¼	None	- - -	- - -	2½	3
Machine dimensions (LxWxH), feet	9'6"x8½	9'6"x8½	9'6"x8½	9'6"x8½	5'x5'6"	8.5'x4.5'x 7.7	7'6"x4	10'6"x4	13'x12'x5	16'x14'x6
Approx. floor space required, sq. ft.	11'x8'x8½	11'x8'x8½	11'x8'x8½	11'x8'x8½	5'x3'x6	80	100	100	200	250
Approx. shipping weight, lbs.	3,250#	3,250#	3,250#	3,250#	400#	12,100	3,000	4,000	8,000	15,000
Special features	Twin station, 2-head.	Twin station, 4-head.	Twin station, 8-head.	Single station, 2-head.	Single station, 1,2,4-head.	Requires no secondary operations, trimming, or reaming.	Suitable for rigid PVC.		Accumulator.	
	Individual stations, each can work with different mold sizes.									
Optional features avail. at extra cost	Overload warning device.					Precompression inj. system. Injection ram speed control.	Molded neck.			
Approx. delivery time, weeks	8	8	8	8	8	4 - 6	6	6	12	14

* At 100 psi. blowing pressure.
\# Without extruder.

Manufacturer*	Producto #						Quality	Royle		
Machine model	Double Press VD-2	Double Press VD-3	Double Press VD-4	Single Press VS-2	Single Press VS-3	Single Press VS-4	HSM #100	5 T	10 T	20 T
Type of preliminary operation, etc.	Extrusion.						Extrusion	Extrusion.		
Method of operation	Automatic.						Automatic	Automatic.		
Number of molds	1, 2, 4, 8.			1, 2, 4.			2	2	2, 4	2, 4
Number of pieces per cycle	Depends on number & type of molds.						2 min.	2	2, 4	2, 4
Hopper capacity, lbs.	Depends on choice of extruder.						100	4*	6*	8*
Platen area, W x D, inches	21x11*	25½x14*	25½x14*	21 x 11*	25½x14*	25½x14*	10 x 18	15 x 15	20 x 20	31 x 31
Clamp tonnage or mold closing force, tons	8½	8½	14	8½	8½	14	1-3/4	5	10	20
Daylight opening, inches	20½-23½**; 9½-12½***		- - -	20½-23½**; 9½-12½***		15½-18½**; 32½-35½***	23	14	18	36
Platen stroke, inches	0-11#	0-11#	0-17#	0-11#	0-11#	0-17#	10	7	9	18
Max. size of part moldable:										
Diameter, inches or W x D	10	10	14	10	10	14	9-3/4	6	8	16
Length, inches	24	30	30	24	30	30	50	30	30	30
Projected cross-section area, sq. in.	312	510	510	312	510	510	145 @ 30 psi.	150	300	600
Dry cycle time (without cooling), min.	0.033## max.	0.033## max.	0.033## max.	0.033## max.	0.033## max.	0.033## max.	0.020	0.021	0.032	0.075
Output, lbs./hr., of finished parts, etc.	Depends on type of extruder.						100	80	125	500
Recommended preliminary machine size, etc.	3½"; 20:1 or 24:1		3½"or 4½"; 20:1 or 24:1	2½";20:1 or 24:1		3½";20:1 or 24:1	2½", 20:1	2", 20:1	2½",20:1	4½",20:1
Tie bars: Number	2	- - -	- - -	2	- - -	- - -	2	2	2	2
Size, inches	2	- - -	- - -	2	- - -	- - -	1½	2	2½	3
Machine dimensions (LxWxH), feet	Depends on type and size of extruder.						8'x7½'x6	- - -	- - -	- - -
Approx. floor space required, sq. ft.	" " " " " "						44	100	125	175
Approx. shipping weight, lbs.	" " " " " "						1,800	9,000	10,500	15,000
Special features	3-way mold positioning adjustment. Equalized mold closing & opening. Accumulator with variable back pressure. Built-in part ejector.						Fast set-ups. Each station can run independently.	Adjustable pressure valving in manifold heads.		
Optional features avail. at extra cost	High-speed automatic strippers. Reamers.						Safety doors.			
Approximate delivery time, weeks	- - -	- - -	- - -	8 - 12	- - -	- - -	3 - 4	- - -	- - -	- - -

* Molds can extend above and below platen.
** Mold open.
*** Mold closed.
\# Adjustable
\## Depending on press stroke required.

* Cubic feet.

	Stokes		Waldron-Hartig		
Manufacturer*					
Machine model	855-2	856-2	45D18	25S8	35D18
Type of preliminary operation, etc.	Extrusion →		Extrusion →		
Method of operation	Auto., Semi-auto., & manual →		Automatic or manual →		
Number of molds	2, 4	2, 4	2 or more	Single or multiple.	2 or more.
Number of pieces per cycle	2, 4	2, 4	2 - 8	1 - 6	2 - 8
Hopper capacity, lbs.	50	150	365	175	250
Platen area, W x D, inches	10 x 20	20 x 27	24 x 24*	16 x 12*	24 x 24*
Clamp tonnage or mold closing force, tons	25	10	18	8	18
Daylight opening, inches	20	28	6-1/8 - 26-1/8; 36-1/8#	6 - 20	6-1/8 - 26-1/8; 36-1/8#
Platen stroke, inches	10	13	10	7	10
Max. size of part moldable:					
Diameter, inches or W x D	9.75	12.75	11;16#	8	11;16#
Length, inches	36¼	36¼	36	18	36
Projected cross-section area, sq. in.	70*	300*	360**	180**	360**
Dry cycle time (without cooling), minutes	0.033	0.065	0.11	0.08	0.11
Output, lbs./hr., of finished parts, etc.	Depends on capacity of extruder. →		500	200	300
Recommended preliminary machine size, etc.	2½";20:1	3½";20:1	4½";20:1	2½";20:1	3½";20:1
Tie bars: Number	- - -	2	4	3	4
Size, inches	- - -	2	3	1¾	3
Machine dimensions (LxWxH), feet	14x7½x8#	14x12x9#	12x17x8##	12½x5x7##	11x15x8##
Approx. floor space required, sq. ft.	100#	160#	14 x 20	13 x 7	13 x 18
Approx. shipping weight, lbs.	7,000	10,000	16,000	9,000	12,000
Special features	Open construction. Easy set-up and operation. →		Hi-speed accumulator ram method. Rapid parison extra controls for var. parison wts. Optimum parison uniformity. →		
			Accumulators avail.	Compact press	Accumulators avail.
Optional features avail. at extra cost	Dual crossheads accumulator →		Single press operation.	Controls for variable parison wts.	Single press operation.
Approx. delivery time, weeks	4-6 max.	4-6 max.	6 - 8	6 - 8	6 - 8

* At 65 psi. air pressure.
\# Includes extruder.

* Between tie rods.
\# With single mold option.
** For 100 psi. blowing press.
\#\# Includes extruder.

PT's Classified List of 1961 Auxiliary Equipment for Extrusion and Blow Molding

In a departure from our previous system of listing Auxiliary Equipment, we are not publishing an extensive listing of domestic manufacturers (and their addresses) for this equipment. A truly comprehensive listing would include the following 23 categories of auxiliaries:

(1). Controllers & Regulators, Extrudate Thickness
(2). Controllers & Regulators, Machine Cycle
(3). Controllers & Regulators, Pressure
(4). Controllers & Regulators, Take-Away
(5). Controllers & Regulators, Temperature
(6). Cooling Devices
(7). Conveyors
(8). Cutters
(9). Cylinders, Extruder
(10). Dicers & Choppers
(11). Dies, Extrusion
(12). Handling Equipment for Extruded Items
(13). Heaters
(14). Hopper Loaders
(15). Liners, Extruder Cylinder
(16). Marking Machines
(17). Mixers, Blending & Coloring
(18). Rewinding Equipment
(19). Screws, Extruder
(20). Slitters
(21). Spooling Equipment
(22). Take-Away Equipment
(23). Wire-Coating Equipment

We will be pleased to supply a complete listing of manufacturers in any one or more of these categories to any reader who requests it in writing from this publication.

Letter from the Publisher

With our next issue, December, the editorial pages of Plastics Technology will come under the direction of a new editor, Lawrence Sandek. Mr. Sandek has a considerable background in the journalism of science and technology. He joins this magazine after two years on the Board of Editors of SCIENTIFIC AMERICAN, before which he served variously as Managing Editor of CHEMICAL ENGINEERING PROGRESS (CEP), Science Editor of RESEARCH & ENGINEERING and public relations account man for, among other firms, Ansco and General Aniline and Film.

We are very pleased to have Mr. Sandek join our staff; we look upon this development as a logical step in PLASTICS TECHNOLOGY's growth, and one which will further augment the magazine's value to its readers and its advertisers.

Our advertising staff has also been strengthened. Mr. James T. Dugan, who has been on the editorial staff of PLASTICS TECHNOLOGY since its inception, now becomes Eastern Sales Manager. The broad and detailed understanding of the industry that he brings to his new assignment uniquely qualifies him to offer valuable service to PLASTICS TECHNOLOGY's advertisers.

Robert B. Carter
Publisher

Guest Editorial

KENNETH ROUZER*

Expected changes in equipment and their effects on you

The question in everybody's mind is: Will new equipment obsolete the ones now in use and, if so, is there anything that can be done about it? In the field of custom compression molding, because of the nature and the condition of the business, there does not seem to be too much activity in development of new machinery. The work that is continually going on is the improvement of preheaters, speeding up machines and so forth; but nothing of any great radical nature that we can see at this time. I believe the biggest change, if any, is going to come from different materials.

The same conditions prevail somewhat in reinforced low-pressure or fiberglas molding. Each molder obviously develops his own equipment, modifies standard equipment to suit his own techniques in his jobs, and, there again, we feel that any great startling change is going to come from materials.

We feel, however, that injection molding presents an entirely different picture. Until recently, the only change in injection molding machines was making them larger, faster, and/or more powerful, whichever suited the need. In fact, the basic features are still on the same machines that were incorporated in the original Isoma machine, which was ¾ ounce capacity unit complete with nozzle shutoffs, and other accessories. Also, one of the first domestic machines produced in this country had preplasticizers. Up to the present time, I doubt if there is anything radically new except greater push, more speed and more power. But now that the molding machine designers and builders are starting to combine the use of screw preplasticizers, there is a possibility of a completely new era for injection molding. As you know, injection molding has always been built around how much material one can plasticize properly in as short a time as possible.

Now just what these new preplasticizers will do and what they look like is certainly a subject for discussion in itself. I don't think there are any two of the domestic machinery manufacturers that agree exactly as to which way to bring about this change. At least they haven't agreed at this point on which way they are going to approach it. For instance, some of the manufacturers are going to use a standard extruder, extruding into a transfer or shooting cylinder. Other machinery manufacturers are going to use the reciprocating screw and shoot into a transfer or shooting cylinder. Others are going to give you a choice of either extruding into a transfer or shooting cylinder, or directly on the screw just by flipping a three-way valve. Others have adopted the straight injection through a reciprocating screw.

One other method, as we know, has been on the market or being used in this country for a year or so now for making containers. Another method which is on import models is a twin screw. I've seen several of these machines operate. They have some proven advantages, as well as some disadvantages. While we can't go into all the disadvantages or advantages at this time, I believe this, that as we build these machines, they will be modified and in a very short time, I think that most, if not all of the injection machines will have to be equipped with some form of extruder preplasticizers. It is also reasonable to expect that we shall not all want the same type of machines or the same type of screw preplasticizers.

With a difference in materials, a difference of your product lines; the custom molder of the future is either going to have to specialize in various types of equipment and materials or broaden his scope of activity to take in diversified molding machines. As a matter of fact, one molding machine manufacturer, taking this into

* Plant Manager, Plastics Div., General American Transportation Corp., Chicago, Ill.

consideration, will shortly come out with a line of 22 different machines to give you almost every conceivable combination of these things. There is probably a question in your mind as to how do we get into this new era? These new machines cost money. Well, the only thing we can suggest is that if you don't care to buy the new machines, we do know that you can alter your old machines in a very practical manner for approximately ⅓ to ½ of the cost of a new machine, and that is a conservative estimate. I'm sure you can stay within that. So, inasmuch as none of the molding machine builders at this time are particularly interested in taking on these reconversion units, you are either going to have to do it yourself or find some subcontract shop that is interested in adopting a screw preplasticizer to your current machine. I understand this is entirely possible.

One other question is: Is there going to be any reduction in the prices of molding machines? I believe we all know that these machines are made from steel, and we are very famiiar with the way steel rates are going; so I doubt if we will see any reduction in the price of the machines. You might get more for your dollar, but they are going to cost more dollars.

Touching on the cost of molds, is there anything new in the building of molds that would tend to decrease the cost of molds? As near as we can figure, there is nothing widespread in the industry that is going to reduce the cost of producing molds. The biggest savings will probably be made through the cooperation of your own engineers and the mold builders themselves. We hope that later there is something we can discover to save you a lot of money. Unfortunately, we are going to spend money, hoping we may get a little more for what we spend.

—The End

Reinforced plastic concrete form pans cut building costs

MFG forming pans being set in place and anchored with nail at each corner. Light weight makes handling and transfer easy.

The use of newly-engineered molded fiber glass-reinforced polyester concrete forming pans on a $8,000,000, five-building residence hall construction project at Pennsylvania State University is credited by Virginia Engineering Co., prime contractor, with significant improvements in cost, speed and quality in connection with this project.

The fiber glass-reinforced polyester pans are molded using a 10-mil surface veil in matched metal dies by the Molded Fiber Glass Co. of Ashtabula, Ohio. They have an outside dimension of 24 x 24 inches, a void of 19 x 19 x 8 inches, a wall thickness of 0.110 inch, and weigh but 6¾ pounds. The long-time resistance to the eroding effects of water, alkali, and abrasive contact with concrete are attributed to the characteristics of the material from which these pans are made and to the specially-engineered surface veil. There has been no "blooming" of glass fibers to the surface of the pans and release from concrete has been easy.

Mold design and close control during molding are said to be key factors in insuring that the pans are true to size and hold these dimensions. No flanges have warped or domes bulged in use to produce less than satisfactory concrete voids. Trueness of edges eliminates problems of alignment and makes it possible for the pans to be set snugly together for a minimum of concrete flash or fins. The pans come ready to use and a single nail anchors and holds in place a corner of four of these forms. Since they don't dent, there is no problem of trying to hammer them back into shape. The concrete surfaces are therefore free from roughness.

The 6,000 MFG pans purchased for this project were the choice of eight differently-engineered pans that underwent rigorous field testing by the contractor. They involved an initial outlay of $35,520, but on the basis of being used 42,000 times, a saving of $6,480 was achieved in comparison with the quoted $1 per pan per pour for steel domes. Virginia Engineering's construction schedule calls for between 7 and 9 pours per form, fiber glass reinforced plastic pans have been used for as many as 25 pours. There is also a saving in shipping costs since these 6¾ pound pans weigh 9¼ pounds less than their steel counterparts. In addition, there is a substantial salvage value since the pans may be reused.

The contractor also attributes savings in time and labor required to handle, erect and strip the form work to the use of the molded fiber glass pans. He states that their cost is running under 6¢ per sq. ft. for setting, stripping, cleaning where necessary, and moving the pans to the next floor, and an estimated 19¢ per sq. ft. for all the rest of the form costs including the setting, removing and transfer to the next floor of the bucks, supporting lumber and plywood pan support floor.

—The End

HERCULES Packaging Hi-Lites

Plastics packaging with "built-in sell"

New polyolefins provide unique new merchandising features

Exciting low-cost packages are possible today because of two new and better plastics: Hercules Pro-fax® polypropylene and Hi-fax® high-density polyethylene. The distinctive qualities in these advanced polyolefins will help make certain that *your* packaging plays an increasingly profitable role in product merchandising.

Whether it is an enveloping bag of clear film to display and protect a product's goodness or a stiff container offering bonus long-term values—Hercules Pro-fax and Hi-fax offer the ideal materials for advancing today's marketing plans for fast, profitable turnover. Some of their singular advantages are demonstrated on these pages.

Simple throwaway packaging or durable containers with "buy appeal" after-purchase functions—whatever your package requirements in performance, appearance, and economy, look into the creative stimulation inherent in the family of modern polyolefins available from Hercules. Your inquiries are invited. Phone or write today.

Pro-fax bag keeps lettuce fresh longer

The introduction of the Kordite 1000 oriented polypropylene lettuce bag created a startling change for the better in produce packaging. Made of Hercules Pro-fax, this packaging film is an excellent moisture barrier—assures that millions of heads of lettuce packaged in Kordite 1000 will retain their freshness longer. The biaxially oriented polypropylene film has sparkling clarity and crispness, high strength and toughness, and offers indefinite storage life. Treated Kordite 1000 is readily printable. Results are clear and sharp, and the ink holds fast to the film, thus adding colorful promotional values to the package.

As a film in cast or oriented form, Hercules Pro-fax polypropylene yields more crystal-clear packaging per pound than any other plastic. Low-cost Pro-fax packaging wraps are available for all kinds of dry and moist products. With excellent resistance to creasing and abrasion, they are heat-sealable and cementable. High resistance to fatty foods and safe sterilization at temperatures to 275°F invite broad application potentials. Most important of all, Pro-fax is FDA approved.

Pro-fax hinges dispense with assembly costs

Pro-fax was a "must" in this unique dispenser-package for RIBBON DOPE* Thread Sealant by Permacel, a new sealer designed for use on threaded pipe joints. Four integrally molded hinges are combined in a single molded part which opens to accommodate a roll of RIBBON DOPE, then folds and locks together to make a lightweight, compact carrier. A snap-in blade cuts tape to any desired length, and the handy unit can be tucked in a pocket or toolbox, stored in any convenient place, or kept available on the worktable. When product success hinges on functionality plus low cost, Pro-fax provides the *most* plastic for the job.

Pro-fax cuts production costs—permits permanent containers like portable typewriter cases to be molded in one piece with strong, tough built-in hinges. Even self-hinged containers for cigarette packs, jewelry, tools, office supplies, and playing cards, for example, can be molded at low cost. Pro-fax is immune to staining, and resists heat and chemical attack.

*Trademark of Permacel

Hi-fax container combines buy appeal with savings

Roman Cleanser, the first major bleach manufacturer to package its products in plastic containers was also among the first users in this market to employ 0.962-density Hi-fax. Economy, maximum stiffness, and low permeation rate make the new Hi-fax series an ideal packaging material for big-volume bleach and household chemical packaging markets.

Three new types of Hercules high-density Hi-fax polyethylene resins in the 0.962 range were recently introduced for injection molding. They are easy to process and go a long way in erasing reject problems. Applications include bottled beverage carrying cases, automotive parts, housewares, large toys, and molded seats for institutional furniture.

HERCULES POWDER COMPANY
INCORPORATED

Polymers Department
Hercules Tower, 910 Market Street, Wilmington 99, Delaware

QPET-6

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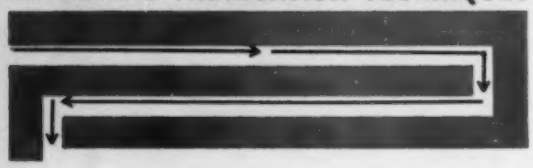
PLASTICS TECHNOLOGY
EXPLORING FABRICATION TECHNIQUES



By L. J. ZUKOR, *ENGINEERING EDITOR*

Radio frequency molding of expandable polystyrene.

The use of radio frequency (R.F.) energy for welding plastic materials has been successfully adapted to the molding of expandable polystyrene beads (EPB).

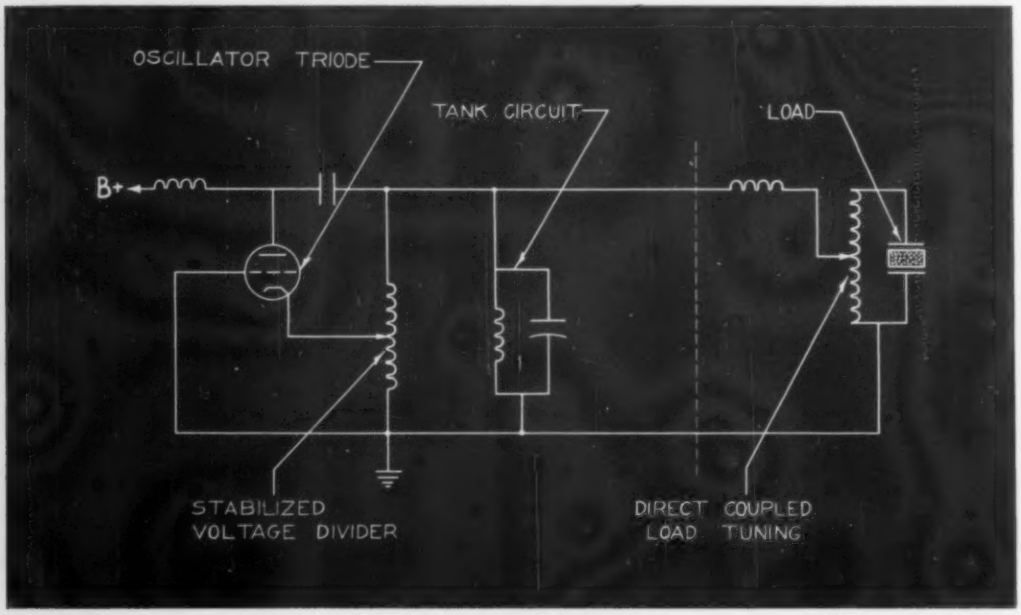
I saw this operation in March, intimated it to be around-the-corner in April, and waited for an automatic machine to be built in order to explain the fabrication technique. Judging from the developments in the various automation methods, and the recent accumulation of data for processing EPB by R. F. heating, this molding method should greatly increase the use of polystyrene foam materials. The parts manufactured at the time were asymmetrically shaped boxes molded in a 12-cavity, compression type mold.

The shape of the part and the fact that material is restrained in a solid mold differentiates this new process from the proprietary Kestral process, which has been the sole dielectric method for EPB molding. Kestral Corp. fills a fabric casing with treated beads and passes it between the electrodes of a high frequency generator. This method depends on the R.F. energy to produce steam which, in turn, expands and fuses the EPB material. The fixed position of the electrodes and the type of chemical treatment used, limits the process to molding symmetrically shaped objects such as life preservers, swim trainers, and floats. It has not yet been successful with asymmetrical shapes, the bulk of which occur in packaging containers and industrial parts. Unlike the standard steam injection method, the Kestral process uses only enough moisture to generate sufficient steam for expansion and fusion. This eliminates long drying and storage periods for the molded parts.

When R.F. energy is used instead of live steam for heating (see our April issue, page 40), it results in shorter cycles which are reflected in lowered manufacturing costs. Also, the molds that are used with R.F. processing cost less than those which are used with steam.

Dielectric heating was first used in the plastics industry about 20 years ago to preheat compression molding (Thermosetting) preforms. It was later modified, as a heat sealing machine for such high loss, polar materials as P.V.C. film and sheet. Low-loss materials such as polystyrene (0.001 at 300 Kc.) are excellent R.F. insulators. Curiously enough, R.F. excitation can now be used to heat these same materials. Here's how.

In electron theory, there is no sharp distinction between conductors and insulators. Substances that in some cases would be regarded as fair insulators would in other cases be regarded as fair conductors. All known insulators will allow some current (leakage) to flow when a voltage is applied to them. Thus, a phenolic resin of ten million ohms resistance would pass a minute current



Radio frequency generator diagram.

Diagram courtesy: Tronomatic Corp.

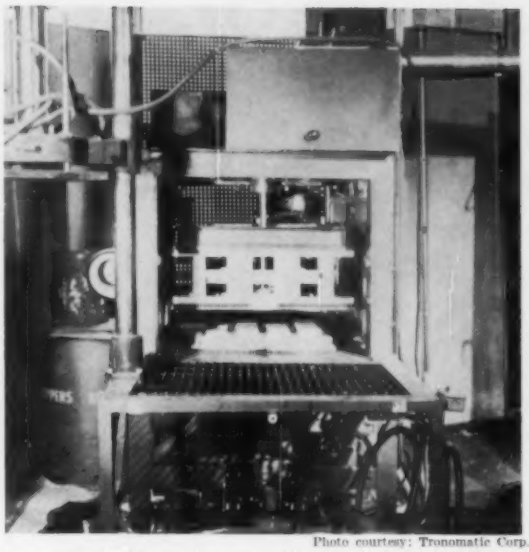


Photo courtesy: Tronomatic Corp.

Front view of R.F. molding press. Shown with front shielding removed and automatic filling mechanism swung to one side.

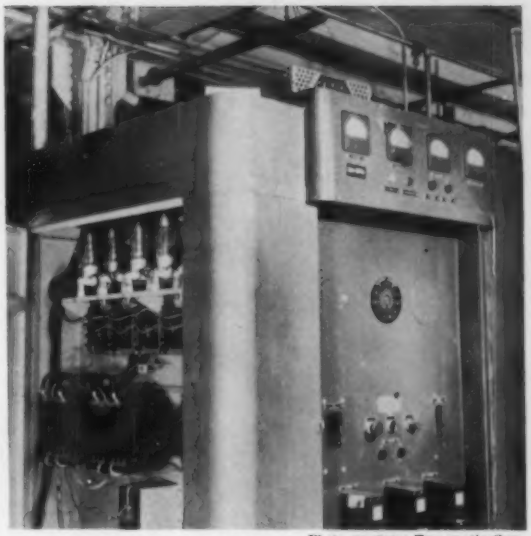


Photo courtesy: Tronomatic Corp.

R.F. generator housed in shielded cabinet.

of 0.00001 ampere at 100 volts. However, if one million volts are applied to this same material, a current of 0.1 ampere would flow, provided the material did not break down. The electrical intensity at which an insulating material breaks down is known as its dielectric strength, and is sometimes expressed in volts per inch of thickness.

The schematic diagram illustrates a typical simplified capacitive circuit coupled to a high frequency generator. It consists of a vacuum triode oscillator whose frequency is determined by a high KVA tank circuit. The tube, operated at 12 kilovolts, and the load (electrodes and dielectric) are fed by a directly coupled inductive circuit which develops over 4000 R.F. volts. This circuit type is rich in harmonics and requires that the press and other radiating portions be shielded in accordance with FCC regulations.

In a capacitive circuit it is possible to have a transfer of current flowing in the external circuit between the plates of a capacitor without actually going across or through the dielectric (plastic) from one plate to the other. When the polarity of a charge is rapidly reversed in a capacitor (as is the case when applying an A.C. voltage) there will be a steady straining of electrons in the dielectric, first in one direction and then in the opposite direction, resulting in appreciable friction. This generates heat, the amount depending on the applied voltage and the (frequency) rate of reversal. When sufficient heat is generated, the plastic (dielectric) situated between the electrodes of the capacitor melts. Some dielectric materials react worse than others at high-frequency currents; e.g., they exhibit high electron loss or

(Continued on page 75)

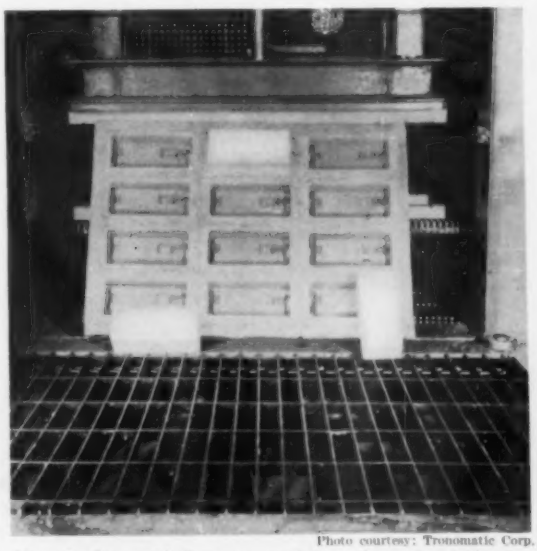


Photo courtesy: Tronomatic Corp.

12 cavity box mold. Boxes are used to package electrical relays.

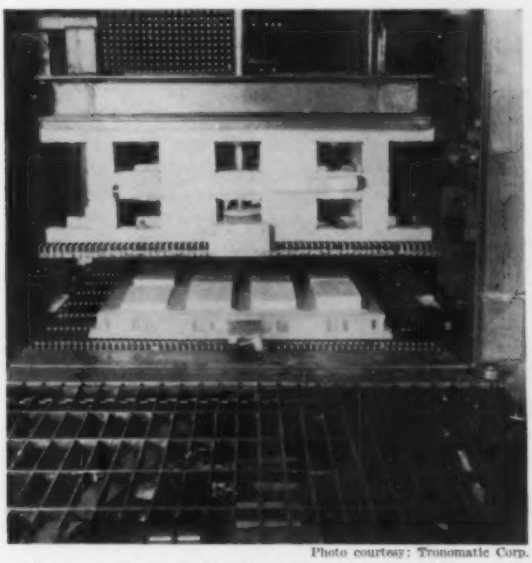


Photo courtesy: Tronomatic Corp.

Box parts being ejected from polypropylene mold.

Compression & transfer molding

Don't forget the melamines!

Edited by: PAUL E. FINA*

The world of plastics is a dynamic one! The organic chemists are in constant search for new polymers affording attractive properties. The purpose being to create additional fields, new demands, and different applications. As a material is initiated into the market, a romance is quickly attached to it. The creative instincts of man are in force.

Such it was when the melamines were introduced as molding compounds in 1939. The properties of melamines were investigated throughout the industrial and commercial world. The consumer was told of this new plastic material. The hardness of the material, the infinite color possibilities, the resistance to solvents and heat, and the electrical insulation, arc resistance and arc tract properties were emphasized. Trade names were established. Dishware for the housewife, buttons for clothes, soda dispenser equipment, cutlery handles, automobile ignition parts, switch boxes, and aerosol dispensers were in the offing. The electrical industry was overjoyed with the arc resistant, dielectric, and general electrical qualities of melamines. Such items for the consumer as dishware, counter and table tops, and buttons were considered successful applications. However, industrial problems began to unfold.

In most parts of the United States of America, dimensional stability of the melamines was in question. Continued shrinkage and warpage were in evidence. The use of melamines generally began to drop wherever dimensional requirements were stringent. Then, with the advent of other thermosets and some thermoplastics, the applications for melamines remained only in the successful fields and usually forgotten elsewhere.

The dimensional problem

The laboratories, however, were at work trying to improve the melamines. The preponderant area of endeavor was to determine the cause and remedy for the continuous shrinkage that was occurring. Exchange of information between nations was sought.

In England, it was noted that melamine formaldehyde molding compounds were usually accepted as being equal in stability to the reliable phenolics. According to unofficial reports, a swapping of melamines between the U.S.A. and England occurred. But the melamines made in England acted about the same in dimensional stability when utilized in the United States, and our melamines acted the same as their melamines when molded in England. Actually, there was no mystery. In England, relative humidity is constant and on the high side.

Quoting Wiliam A. Laurie, Research Director, Melamine Plastics Corp., the following is his explanation for the cause of continuous shrinkage in melamines: "To better understand the problems of dimensional stability in melamines, it is necessary to consider some of the fundamentals of melamine resin condensation. Melamine resins are formed by the addition of formaldehyde to 1,3,5-triamino triazine and the subsequent condensation of the monomeric methylol melamines thus formed.

It is readily evident from the formulas for melamine resin formation that water and formaldehyde are the by-products of melamine condensation. The point emphasized here is the extent of water formation or volatiles given off during melamine resin formation.

If one then considers the cumulative effect of low molecular weight resins, virtually monomeric, and the amount of condensation of chemical water generated, one is able to envision dimensional stability problems caused by both the change from low molecular weight polymer to high polymer and the accompanying stresses caused by entrapment of only a small fraction of the water of condensation."

The possible solution

Continuing with Mr. Laurie's statement: "the problem has been given considerable thought by Melamine resin

* Director of sales engineering, Fiberite Corp.

chemists. To date, the most promising approach appears to be the incorporation of a plasticizer. The function of the plasticizer is primarily two fold: (1). by eliminating potential cross-linking sites, the internal stressings are minimized; and (2). the rate of cross-linking or attainment of the infusible state is retarded. When plasticizers are included in melamines, the molding powder can be compounded to a lower volatile content. The dependence of plastic flow on volatiles and the effect of volatiles on molded shrinkage has been shown in many studies.

"However, it is only by the use of high plasticizer containing resins that low volatile molding compounds with sufficient flow or plasticity are obtainable. It is thus seen that some measure of dimensional stability improvement can be obtained by substituting the plasticizing action of 'labile' water with a more permanent chemically acting plasticizer. Toluene sulfonamide, and in particular para-touene sulfonamide is, to date, the preferred plastizicer for melamine resions."

Thus, it is, that melamines are on their way back. Plasticizers are being incorporated to eliminate the chemical water entrapment. Shrinkage and post-shrinkage are being reduced. Molding qualities are being improved. Fillers are being substituted (both) for physical properties and plasticizing effects.

Cure times, cure uniformity, and part design are being studied carefully. Due to the plasticizer effect, harder flows (with less volatiles) are being used in molding. The close control of the variables (volatile content, resin-filler bond, and the uniformity of cure) has most significantly improved the dimensional stability and warpage resistance of melamine moldings. These developments allow the design engineer to confidently specify plasticized melamines for both large moldings and flat surfaces. It should be mentioned here that most of the work has been done for the industrial melamines, rather than the commercial (dishwater-type) molding compounds.

In conclusion, though much work remains to be done on melamine resins and melamine compounds to make these materials as conveniently moldable and as permanently stable as the phenolics (i.e. to all aging conditions), enough progress has been made to bring them back into the industrial field. Such properties as fire resistance, heat resistance, hardness of all plastic surfaces, clearness of resin (coupled with its resistance to discoloration), oil and grease resistance (table-top surfaces are proof of this resistance), color potential, and last, but not least, the unbeatable electrical and electronic properties, clearly indicate that melamines should not be forgotten.

—THE END

Exploring Fabrication Techniques

(Continued from page 73)

have a greater tendency toward breakdown and heat up too readily. These materials would not be useful as dielectrics in radio capacitors, but because of this characteristic, can be processed or heat sealed when included (as the dielectric) between the electrodes of a capacitor in a capacitive circuit. Conversely, a low-loss material will not break down as easily nor heat as readily. Unaltered polystyrene, with its extremely low-loss characteristic, will not ordinarily heat at reasonable voltages and frequencies.

How then can this material be processed by R.F. heating? One way is to modify the pre-expanded bead by adding a high-loss substance to the bead's surface, such as a wetting agent combined with a metallic soap or salt. This method, developed by Koppers, forms the basis of the Kestral process. The other is the Dynaspan process, developed by Richard C. Bailin, in which a high-loss compatible additive is incorporated either on the surface of the pre-expanded bead or in the bead at the time of polymerization. The basic difference between the two systems is in the method by which heat transfer to the polystyrene is accomplished. The Dynaspan process transfers heat directly by conduction from the high-loss material, while the Kestral process heats the high-loss material which, in turn, vaporizes the moisture. The steam thus formed heats and melts the polystyrene. Dick Bailin, working with a modified vertical Tronomatic press, has successfully arranged electrodes and tailored the R.F. generator circuit in a combination which allows the beads to be processed in a compression type mold. Ejection of finished parts also follows standard compression molding practice, i.e., using shop air or knock-out pins.

It is apparent from the above that the mold must be constructed with low-loss materials which must be able to withstand the fusion temperature of polystyrene. Another requirement is that the mold material be non-compatible with and offer good release from polystyrene. Polypropylene proved a suitable material; other materials (depending on the application) are certain wood products, and polyester or epoxy compounds used individually or in combination. Dick pointed out the requirements of a mold for his process, some of which are mutually exclusive. The material must, for example, have a low-loss factor for vertical surfaces but a relatively high-loss factor for horizontal surfaces. The mold material must have, among other qualities, a heat distortion temperature of over 225°F.; a low coefficient of thermal expansion; good heat conductance but sufficient strength to withstand the pressure of the expanding gas contained in the beads. Since no single material meets these requirements several must be used together to yield a mold with the desired characteristics.

When, in the live steam process a fragile skin is fused and covers unfused beads in liquid carrying containers, "leakers" are not apparent until they become embarrassing failures in service. Molding with R.F. "cooks" the material from inside to outside and can guarantee "non-leakers" by visual inspection. When the skin shows complete fusion, the internal material without a doubt is also completely fused.

At the present writing, the Dynaspan process has produced parts in densities from 1.5-3.5 lbs/ft.^{3} and in all normal molding size beads. Dynaspan Corp. has successfully manufactured parts in regular pilot production from Dow's Pelespan 8, .27, .30, and Koppers' Dylite F.40c and S.E. (self-extinguishing) materials. Some of these materials, especially the S.E., have been extremely difficult to mold by the live steam process.

—THE END

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Awnings	■		■	■	■	■	■	■	■	
Baby Wear			■	■	■	■	■			■
Coated Fabrics	■	■	■	■	■	■	■	■	■	■
Coated Paper			■	■	■	■	■			■
Cover Cloths		■	■	■					■	■
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Garden Hose	■	■						■	■	
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Inflatables		■						■	■	
Industrial Tapes				■	■	■	■			■
Organosols	■	■	■	■	■	■	■	■	■	■
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Pigment Grinding			■	■	■	■	■			
Plastisols	■	■	■	■	■	■	■	■	■	■
Rainwear	■	■						■	■	
Shoe Stock			■	■	■	■	■		■	■
Shower Curtains	■	■	■	■		■		■	■	
Storm Windows	■	■						■	■	
Surface Coatings	■	■	■	■	■	■	■	■	■	■
Surgical Tape Tubing				■		■	■			■
Upholstery Sheeting	■	■	■	■	■	■	■	■	■	■
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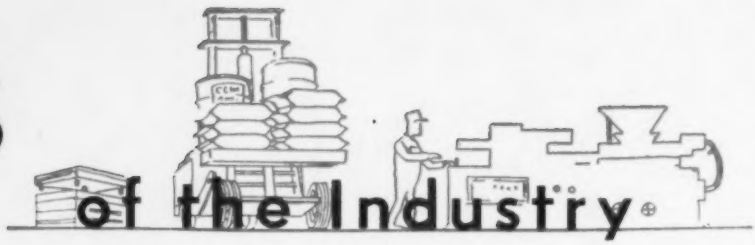
NEWS of the Industry



new plants, labs & additions

Cary Chemicals, Inc., is building a 100-million pound per year PVC plant in Burlington Township, N. J. Raw materials will be supplied by Tenneco Chemical Co., a subsidiary of Tennessee Gas Transmission Co., with which Cary recently completed a financing, marketing, and production association.

American Cyanamid Co. has opened a new melamine plant in Gosport, England. Annual output is expected to be about 3,000 tons.

Lawter Chemicals, Inc., has opened a Hi-Viz fluorescent pigment plant in Rexdale, Ont.

Dynaspan Corp., with Richard C. Bailin, president, was organized in May 1961 to operate a pilot plant molding facility for expandable polystyrene beads by a radio frequency process for the Tronomatic Corp. The R. F. equipment used will probably be furnished by Thermatron Co. who helped develop the machinery used by the Kestral Corp.

Frank W. Egan & Co. held Open House at its Somerville, N. J. plant on October 20 to celebrate its 15th anniversary and the completion of an $350,000 expansion program which doubled its plant facilities by adding 38,000 square feet of space, 26,000 square feet of which is devoted to manufacturing and 12,000 square feet to engineering, general office and other service activities. The firm, which is a leading manufacturer of plastics extrusion coating machines and machines for extrusion and blowing of film, was organized by the late Frank W. Egan, whose sons Edward F. Egan and Lawrence W. Egan are president and vice president and secretary, respectively. William H. Willert is vice president in charge of the plastics division. The present plant expansion brings the company's entire manufacturing operation, which includes machinery for paper converting, rotogravure printing, textile finishing, and metal forming, under one roof.

changes in ownership

Space Equipment Corp. has been organized in Torrance, Calif., to design and produce missile and space products using high temperature plastics.

Thatcher Glass Mfg. Co. has licensed Peerless Tube Co. to manufacture plastic squeeze tubes in Bloomfield, N. J.

International Plastics Industry Consultants is a newly-formed consultancy firm located in St. Petersburg, Fla. A listing of consultants and their specialties should be completed by the end of the year.

Fortune Chemical Corp. has been formed to manufacture plastisols, organosols, and allied compounds. The new firm is a subsidiary of Kaysam Corp. of America, and will be located in an extension to the present Kaysam building in Paterson, N. J.

Fiberfil, Inc., Warsaw, Ind., has formed a marketing alliance with Liquid Nitrogen Processing Corp., Malvern, Pa., and will market the latter firm's line of fiberglass-reinforced Teflon FEP molding compounds.

Allied Chemical Corp., plastics division, has completed new facilities in Orange, Tex., which will double capacity for polyethylene production.

Packaging Corp. of America, Evanston, Ill., has acquired Expandable Plastics Co., Akron, O., as part of its continuing expansion in the field of expanded polystyrene.

Rowland Products, Inc., Kensington, Conn., has been licensed by Eastman Chemical Products, Inc., to extrude and distribute Uvex butyrate sheet.

Henolite Products, Inc., is a newly formed corporation for molding expandable polystyrene. Operations begin at Phoenixville, Pa., early this Fall.

Borden Co. has acquired Columbus Coated Fabrics Corp., Columbus, O., which will continue under present management as a Borden subsidiary.

Fluorocarbon Co., Anaheim, Calif., has puchased Global Packing Co., of Palo Alto, which will operate as a wholly-owned subsidiary.

Plastic Age Co., Saugus, Calif., has acquired from Glastrusions, Inc., equipment and patent rights to a process for continuously extruding reinforced plastic structural shapes.

Northwest Plastics, Inc., St Paul, has purchased Hermitage Plastics, Nashville, Tenn.

(Continued on page 82)

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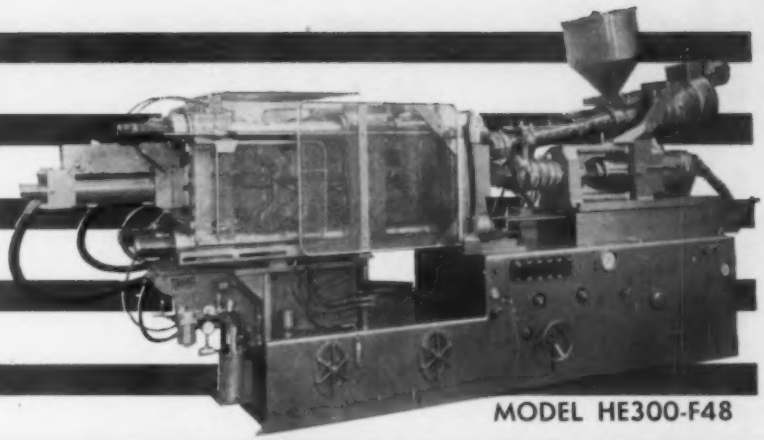
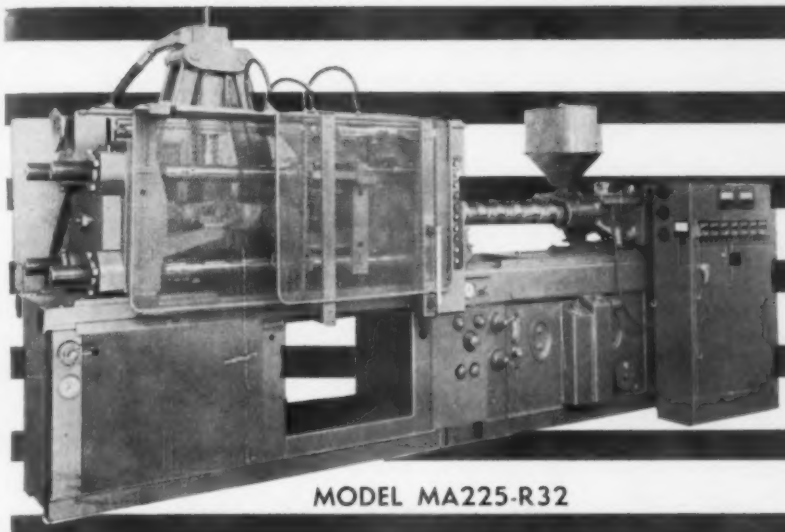


MODEL HE300-F48



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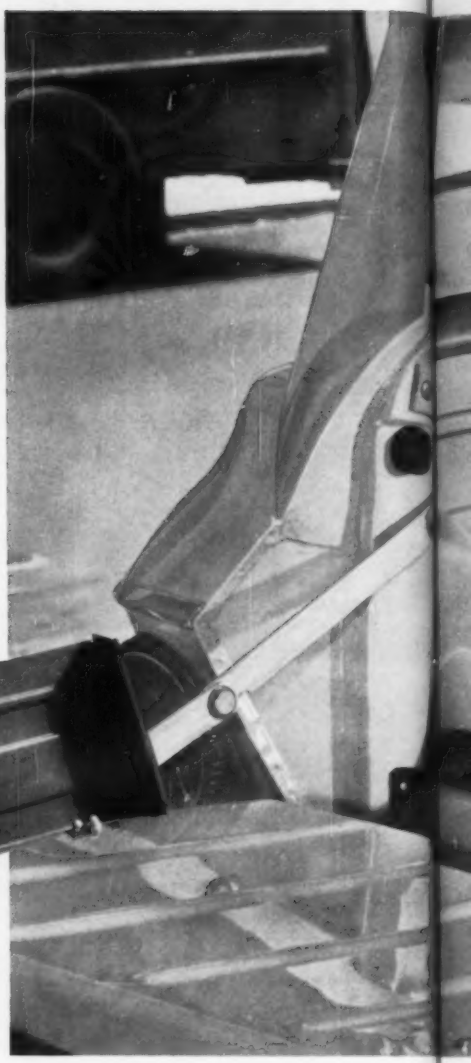
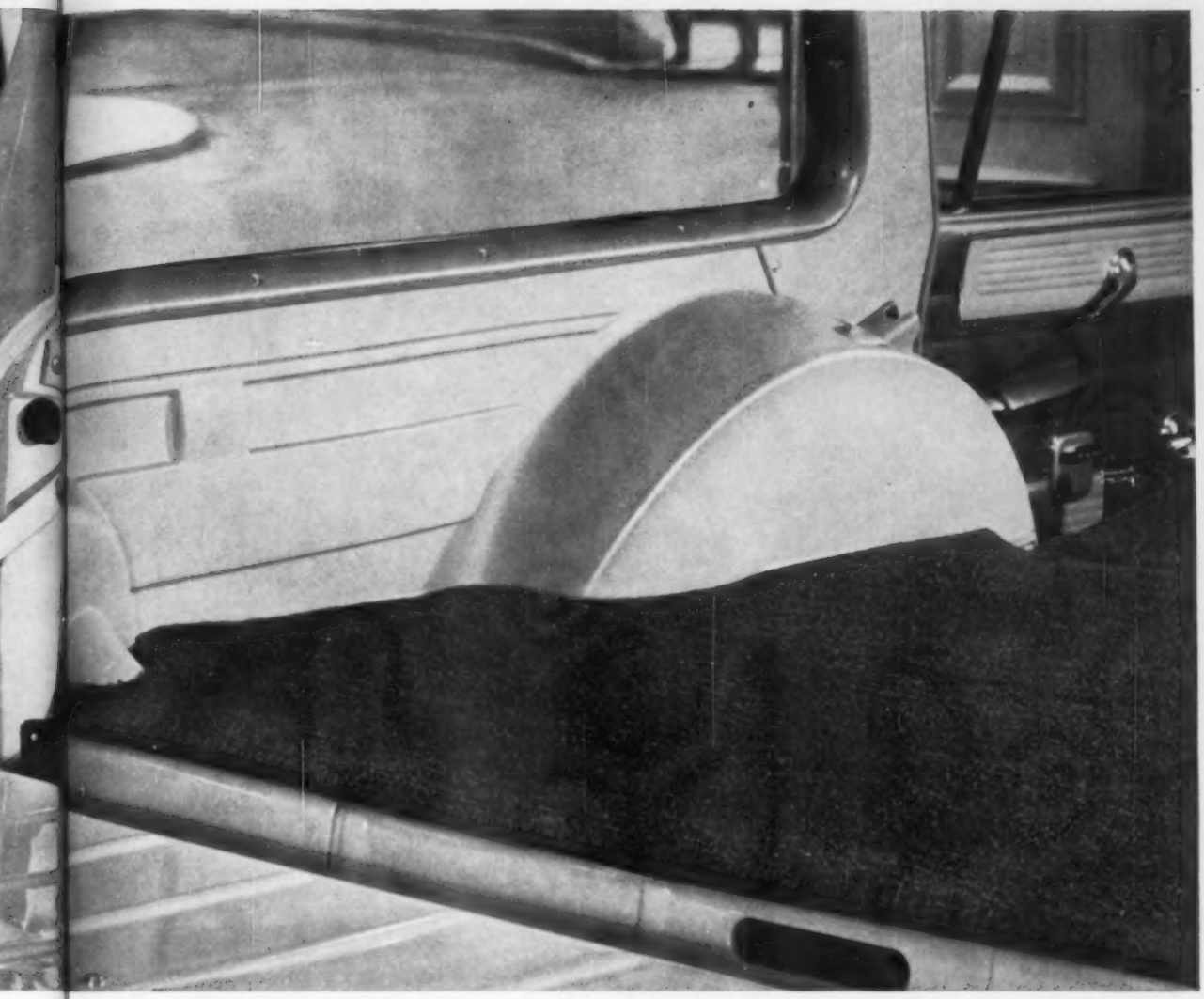


LOOK AT THESE TEST VALUES:

	DPD-7070	DMD-7002
Density, gm/cc	0.945	0.950
Melt Index, gm/10 min.	8.0	7.5
Secant Modulus, psi (stiffness)	70,000	100,000
Flex Life, Flexes to Fail 55 mil Thick Specimen	14,000	14,000
Brittle temp., °C (D746)	−100	−95
[1]Low Temp. Brittleness, °C	−30	(Rm. Temp.)
[2]Room Temp. Toughness, ft.	d.n.b.	5

[1]Min. temp. at which injection molded dishpans (stock 450° F) are good when a 10-lb. rod at 3 ft. height is dropped on dishpan sprue.

[2]Maximum height from which a 5-lb. rod can be dropped on the sprue of injection molded dishpans without damage to the dishpan. "d.n.b." indicates that the material does not break at room temperature.



BAKELITE DPD-7070 High-Rigidity Polyethylene Copolymer gives 1962 RAMBLER Station Wagon cargo panels impact strength and high rigidity.

To obtain toughness, rigidity was usually sacrificed—until Union Carbide Plastics developed BAKELITE Polyethylene Copolymers for injection molding.

Cargo panels for gleaming new 1962 RAMBLER station wagons provide an excellent demonstration of DPD-7070's unique performance advantages. Despite its size—60 inches from end to end—the rigid panel, injection molded with gates at only two points, is lightweight, easy to handle and install. In use, it offers RAMBLER owners high impact strength despite temperature extremes . . . superb scuff resistance . . . handsome good looks (the color goes all the way through). Check the chart (left) for an idea of the performance properties of DPD-7070 and DMD-7002, a BAKELITE Polyethylene Copolymer with extra-high rigidity.

If you're looking for new ways to make bigger profits, take a good long look at *all* the BAKELITE Polyethylene Copolymers. And don't forget that Union Carbide Plastics supplies industry with a full line of low-, medium- and high-density BAKELITE Polyethylenes for injection and blow-molding. For help, write Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada:* Union Carbide Canada Limited, Toronto 12.

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News of the Industry (Cont'd. from page 78)

Bemis Bro Bag Co., Boston, Mass., has entered into an agreement with the Plastic Film Co., Inc., Plainfield, Conn., to acquire its assets and business as of January 2, 1962, and to operate Plastic Film as a wholly owned subsidiary. Plastic Film specializes in the coating and laminating of a wide variety of materials, including paper, plastics, foil, and films.

Hooker Chemical Co. has announced that President Arturo Frondizi of Argentina has approved that company's investment in Duranor, Industries Quimicas Sociedad Anonima Industrial y Commercial, an Argentine affiliate formed to produce phenol using the Hooker process. An equivalent stock interest in the jointly owned company will be held by Atanor, Compania Nacional para la Industria Quimica, S.A. M., a major Argentine manufacturer of chemicals and plastics.

Terafilm Corp., an affiliate of Acme Packing Corp., has constructed a new plant in Orangeburg, N. Y., for the production and distribution of Terafilm, a film made of Tenite polyester. Tenite is a trademark of Eastern Chemical Products, Inc.

Paramount Packaging Corp. has consolidated its eastern operations in a new plant located at Chalfont, Pa., suburban Philadelphia.

California Oil Co.'s Eastern division plans to erect a 30-million pound per year phthalic anhydride plant at Perth Amboy, N. J. Completion is expected for fall of 1962.

Houdry Process Corp. is constructing a second DABCO (triethylenediamine) plant at Paulsboro, N. J. Completion is scheduled by the end of the year. The catalyst is used in the production of polyurethane foam.

General Electric Co. has opened a $500,000 Lexan polycarbonate manufacturing engineering laboratory at Mount Vernon, Ind. The facility will increase developmental work on copolymers, elastomers, and film.

business developements

An-Cor Industrial Plastics, Inc., has announced the appointment of Oakwood Associates of Nanuet, N.Y., as exclusive sales representative for its reinforced plastics tanks and ducting in eastern New York and Connecticut.

Du Pont's Explosives Department has developed an improved cellulose acetate flake which is said to permit higher production rates. A working association has been established with Plastic Materials & Polymers, Inc., Hicksville, N. Y., for conversion of the material into molding and extrusion compounds.

Rexall Chemical Co. is now marketing a complete line of polypropylene resins from warehouses in Holyoke. Mass., Chicago, Ill., and Santa Ana, Calif.

Pangborn Corp., Hagerstown, Md., has established a department for the production and sale of plastics and rubber finishing machinery. William A. McCormick, Jr., will be manager.

Monsanto Chemical's market research department estimates that 972-million pounds of plastic (19%) of total production) were used in construction in 1960.

news from abroad

Goodyear Tire & Rubber Co., Akron, Ohio, has signed a ten-year agreement with Toyo Spinning Co., Ltd., Osaka, Japan, to furnish technical "know-how" for the design, construction and start-up of a 10 million pound a year plant for the production of Vitel polyester resin to be built in Japan. Vitel resin is used in the United States by Beaunit Mills to make a synthetic textile fiber called Vycron.

Marbon Chemical Division of Borg-Warner Corp. has announced the purchase of a plant site Grangemouth, near Edinburgh, Scotland, for the construction of a plant to cost somewhat less than $5 million for the production of Cycolac brand polymers and other synthetic resins.

Tennessee Eastman Co., a division of the Eastman Kodak Co., will license Showa Kenko K. K. of Tokyo, Japan, to produce highly crystaline, "stero-symmetric" polypropylene. This Eastman polypropylene is said to differ from other polypropylenes in its polymeric configuration and crystallizability and to have outstanding physical properties including stiffness, high melting point, and tensile strength.

Rhodiaceta's plastics division has developed two heat-resistant nylon-technyl resins, AP Chaleur No. 2 Noir and DP Chaleur No. 2 Noir.

Danubia Petrochemie A. G. has opened a polypropylene plant at Schwechat, near Vienna, Austria. Annual capacity is 10-million pounds per year. The firm is jointly owned by Montecatini, and Oesterreichische Stickstoffwerke of Linz.

Progil-Bayer-Ugine has opened an isocyanate-polyether-polyester plant at Pont-de-Claix, near Grenoble, France. This firm is jointly owned by two French firms Progil and Ugine, and by the German firm of Farbenfabriken Bayer.

Meiki Co., Ltd., Nagoya, Japan, has developed what is said to be the biggest injection molding machine in the world, Model SJ-150. Shot capacity is 1,100 ounces, platen size is 2,100 by 1,360 millimeters, injection pressure, and maximum clamping force is 2,500 short tons. The unit is a single, in-line screw type which operates continuously.

For more information check Readers' Service Card No. 129➔

PLASTICIZERS FOR VINYLS THAT REALLY GO PLACES

In 1960, for the second successive year, vinyls shared the honor of being one of only two plastic materials to break the billion-pound-per-year mark.

In this growing market, RCI PLASTICIZERS and stabilizers continue to meet an ever-increasing number of vinyl industry requirements. The newly combined RCI and Deecy line includes many ready-made plasticizers as well as a number of customer-tailored ones – all developed to help you increase your products' market-ability.

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RCI's service laboratories stand ready to help you solve specialized plasticizer problems and invite you to outline your specific needs. Write to Plasticizers, Reichhold Chemicals, Inc., RCI Building, White Plains, N.Y.

REICHHOLD

Names in the News

Dr. G. B. Kistiakowsky

Dr. George B. Kistiakowsky, professor of chemistry at Harvard University, and recently special assistant to former President Eisenhower, has been elected to the board of directors of Cabot Corp. **Francis Olmsted** has joined Cabot as assistant to **J. Boyd Britton,** vice president, development. Mr. Olmsted had been with U. S. Industrial Chemicals Co., Div. of National Distillers Corp.

Frank H. Wilson has joined Foster Grant Co. and product manager of nylon film, sheet, and monofilament in the plastic sales division. He was most recently with the film division of Olin Matheson Chemical Corp.

F. G. Bemis, Jr., director of allied operations for the Bemis Bro. Bag Co., and responsible for operation of the company's Visinet Mill, paper specialty and plastics packaging plants, has been elected a vice president of the company. **John S. Whitney** has been named western regional sales manager with offices in Chicago of Air Formed Products Corp., a subsidiary of Bemis. Air Formed Products has opened a sales office in New York City with **Walter Conway,** eastern regional sales manager, in charge.

H. E. Martin has become chairman and chief executive officer of Metal & Thermit Corp. Replacing him as president is **Charles J. Beasley,** formerly vice president and secretary. **H. W. Buchanan,** previously a vice president, has been named executive vice president.

B. Ross Nason

B. Ross Nason has joined Mobay Chemical Co. as director of manufacturing and engineering. Mr. Nason was formerly with Monsanto Chemical Co. where he held positions as director of manufacturing, assistant director of engineering, and plant manager in the firm's Inorganic Division.

S. P. Thomes, Mobay's director of engineering since 1958, will join Monsanto as construction superintendent in charge of a new ethylene plant being built in Alvin, Tex.

William J. Houston has been appointed executive vice president and **Dr. H. W. Schultze,** technical director of the Nuodex Products Div. of Heyden Newport Chemical Corp. Mr. Houston had been vice president-marketing and Dr. Schultz , manager, catalysts of the Div.

J. Eichorn

J. Eichorn has been named special projects manager for the Plastics Department of the Dow Chemical Co., a new position designed to help reduce the time and cost gap between research and sale of a product. He was formerly division leader in Dow's Physical Research Laboratory.

Charles F. Blaich, Jr., has been appointed supervisor of the Urethane Technical Service laboratory, Rubber Chemicals Dept., American Cyanamid Co. Mr. Blaich was associated previously with the Carwin Chemical Co. as group leader for both technical and market development of urethane elastomers and adhesives.

A. O. Redland

Miles Powell, Jr., has joined Chemplast, Inc., East Newark, N.J., processors of industrial Teflon products, as general sales manager. Mr. Powell had been with DuPont's Plastics Div. for the past eleven years in key positions in production, development and marketing.

T. S. Bushnell has been promoted to the new position of sales manager, special products, of Tube Turns Plastics, Inc., manufacturer of fittings and components for plastic piping. **James L. Sheehy** succeeds Bushnell as Midwest district manager in Chicago and Cliff M. Springmeier succeeds Sheehy as West Coast northern district manager in San Francisco.

Dr. Carl E. Barnes

Dr. Carl E. Barnes has joined FMC Corp. as vice president for research, wherein his responsibility will be direction of the research, development, and patent activities of the firm's chemical divisions. For the past eight years Dr. Barnes has been a research executive of Minnesota Mining and Manufacturing Co.

Jerome Formo will become a vice president for research and development of Plastics Corporation of America, Inc. He will also be a director of the company.

Dr. H. M. Walton has been promoted to research associate in the research and development division of A. E. Staley Manufacturing Co. Formerly with the exploratory group and for the last six months a member of the polymer group, Dr. Walton joined Staley in 1957 as a senior research chemist.

William Wishnick

The election of **Rudolf G. Sonneborn** as chairman of the board of Sonneborn Chemical and Refining Corp. and **William Wishnick** as president and chief executive officer has been announced by Witco Chemical Co., Inc. Mr. Sonneborn was formerly president of Sonneborn. Both he and Mr. Wishnick continue as Witco directors. Mr. Wishnick also continues as Witco's executive vice president.

Campbell W. Finley has been appointed assistant to Karl E. Prindle, vice president for research and product development, Dobeckmun Co. Mr. Finley, who has been assistant to the general sales manager since 1958, will be responsible for liaison between the sales and product development groups.

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at competitive price... induction-heated water-cooled extruder

AETNA-STANDARD MODEL 150

Model 150 has the same superior design, same induction heating and water cooling features as the bigger, deluxe Aetna-Standard extruders. Delivers increased production (up to 1500 lbs./hr.) with less scrap on extrusion coating, laminating, blown film or flat film operations. 2½" to 6", 20:1 and 24:1 L/D ratios. Floor or carriage mounted.

We can make quick delivery on this popular machine. Write or call for more information. Ask for a free Plastics Weight Calculator... a new, advanced useful tool.

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DILTS DIVISION
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Names in the News (Cont'd.)

J. S. McBride has been appointed eastern sales representative for the industrial glass fabrics department of J. P. Stevens & Co., Inc. Until joining Stevens as technical service manager for the department, he was associated with Owens-Corning Fiberglas Corporation.

Dr. Walter H. C. Rueggeberg, director of research and development at Atlas Chemical Industries, Inc., has been elected a vice president of the company, which he joined in 1955 as director of chemical research.

As assistant to the president of Goodrich-Gulf Chemicals, Inc., **Cleveland Lane** will assume the supervision of public relations and other assignments for the president.

John J. Speed has been named manager of special projects, a new position in the chemical group of General Aniline & Film Corporation. With the company since 1951, his prior position was personnel relations manager at the Rensselaer, N. Y. plant.

Laurence O. Trerotola, development engineer for the plastics division of Nopco Chemical Co., has moved from the North Arlington, N. J. headquarters to the St. Louis, Mo. office.

Fred W. Stakelbeck

Warren A. Brown

Warren A. Brown, formerly president of R. D. Wood Co., has been elected chairman of the board of directors. Prior to being president of the company, which he served for 36 years, he was vice president in charge of production.

Fred W. Stakelbeck succeeds Mr. Brown as president and chief executive officer. He was previously executive vice president of North American Smelting Co.

John K. Harvey has been named product manager—propylene oxide and amines in the industrial chemicals groups of Union Carbide Chemicals Co., N. Y. C. He leaves the company's South Charleston, W. Va. plant, where he was assistant manager.

Robert E. Kinnen, formerly of Dunlop Tire & Rubber Corp., has joined Seiberling Rubber Co. as director of merchandising and advertising. He assumes the duties of **Douglas Mueller,** who left to join Borg-Warner Corp.

Cecil "Skip" Holland has been designated vice president and treasurer of Fiber Glass Industries, Inc. Mr. Holland, who joined the firm in 1957, was elected to the board in December, 1960.

Monsanto Chemical Co. has made three elections in its St. Louis office. **Felix N. Williams,** a member of Monsanto board of directors, executive committee, and vice president of personnel, has been elected to the board of directors of Plax Corp. **Thomas M. Rasmussen** and **George F. Wingard,** both assistant directors of the company's treasury department, have been elected assistant treasurers of the company.

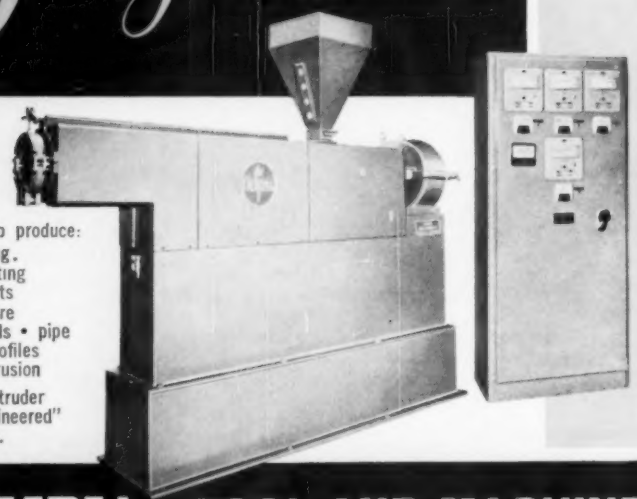
Duane C. Searl has been named manager of quality control of Molded Fiber Glass Co. He will be responsible for establishing and maintaining product standards and working with research and development on testing materials and products.

William T. Stopford has been promoted from sales manager to general manager of Boonton Molding Co. He assumes direction of all activities for the company, which he joined in 1944.

John D. Cruikshank has been promoted from process engineer in the film development section of AviSun Corp. to senior process engineer in that section.

OLYMPIA

"Imagineered" EXTRUDERS



If you plan to produce:
- blow molding.
- film & sheeting
- monofilaments
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- tubing • rods • pipe
- shapes • profiles
- general extrusion

an Olympia extruder can be "imagineered" to your needs.

ARE DESIGNED TO INTERPRET EXACT CUSTOMER REQUIREMENTS.

No one ever buys a standard extruder, because no one application is exactly the same in its requirements. Each must be customized to a certain degree by varying the screw, h. p., heaters, cooling systems, control panels, etc. Determining the right combination for your application takes "imagineering" that can only come from years of designing and building experience and an extra measure of creativity. Olympia has 20 years of extruder design and building experience and a host of satisfied customers who can testify to the high degree of creativity employed to solve their specific problem. Why not put Olympia to work on your problem. Basic specifications for extruder sizes ranging from 1½ to 6 with L/D ratios from 20:1 to 24:1.

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The optical properties of Glidden *Zopaque* Titanium Dioxide—high opacity, hiding strength and tinting power—are helping to sell countless plastic products, from radio shells, pencils, cosmetic bottles and upholstery, to floor tile that will outlast the building it's put into.

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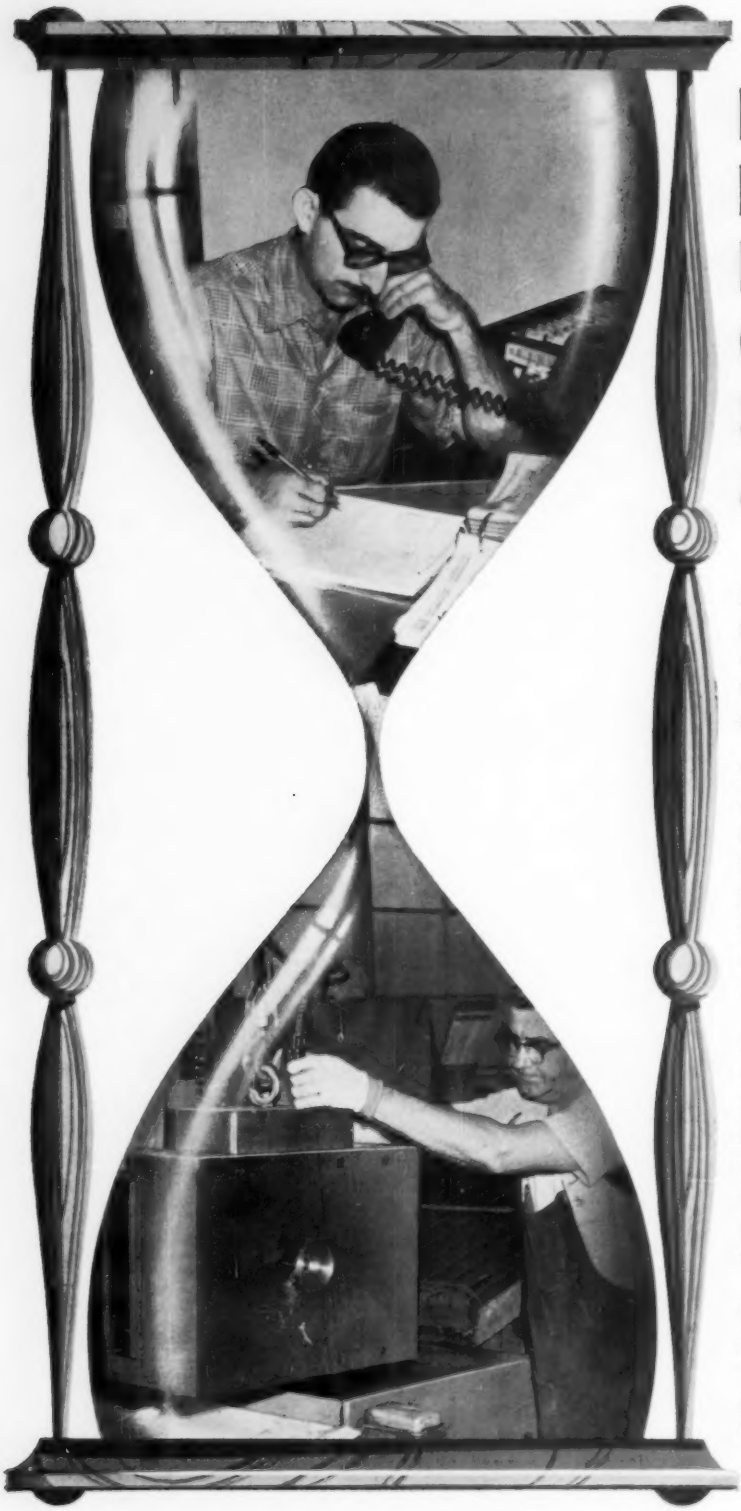


NOW! D-M-E STANDARD MOLD BASES (any of 7000 sizes) SHIPPED WITHIN 48 HOURS

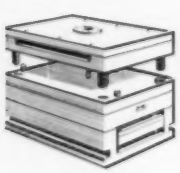
Moldmakers can now cut days off their mold delivery time and meet the most demanding production schedules, still using the very finest precision-built mold assemblies available.

To make this possible a giant step in rapid delivery service has been taken by D-M-E Corporation. 60% of all D-M-E Standard Mold Bases are shipped immediately from local stock! The remaining are shipped in 48 hours or less. And that's from a selection of over 7,000 Mold Base combinations . . . the most complete range in the industry!

From the smallest Mold Base (9⅞" x 8") to the largest (23¾" x 35½"), in either medium carbon or alloy steel, D-M-E Corporation provides you with the fastest delivery service available today. And this time-saving service also applies to our complete range of Cavity Retainer Sets and Mold Plates.

To you this new service means greater savings in time and shorter mold deliveries . . . further enabling you to cut mold costs and increase profits! Contact your nearest D-M-E Branch and start saving now!

62-B-P



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MOLD PLATES • EJECTOR AND CORE PINS • EJECTOR SLEEVES • SPRUE BUSHINGS • MOLDMAKER'S TOOLS AND SUPPLIES

For more information check Readers' Service Card No. 133

New Materials

For more information check Readers' Service Card (p. 121)

Mold release agents for urethane foams

Brulin & Co., which introduced its first mold release for urethane foams, Perma-Mold Formula 1-27, in 1956, has now developed a full line of such release agents for use with practically all types of these foams. The Brulin mold release agents are non-aqueous, colloidal dispersions of waxes and resins. They do not contain silicones, acids, alkalies, amines, or toxic solvents. Some of the properties of these Brulin release agents are listed in the table below:

Formula	Consistency	Color	Non-Volatile Content, %	Approx. M.P. of Solids, °F.
1-27	viscous liquid	light yellow	23-24	160
2-27	paste	none	16-18	140
3-27	vis. liquid	none	17-19	180
11-47S	thin gel	none	12	210
315-106	varies between thin gel and light paste	none	16-18	175
511-02	vis. liquid	none	12	195

Formulas 1-27 and 2-27 are widely used for flexible prepolymer foams. For flexible, one-shot foams, Formulas 511-02, 11-47S or 3-27 are suggested while 315-106 will give superior release for many systems. These release agents can be applied by hand using a clean cloth or brush or by conventional spraying equipment, although 2-27 must be heated before it can be sprayed at room temperature. Best results are obtained when the material is applied in a thin layer and all of the solvent is allowed to evaporate before the foam compound is poured into the mold. Several releases may be obtained with one coating but for precision molding the buildup should be removed periodically.

All of these formulations can be supplied at different consistencies and in faster drying versions, if desired. For foam used in food handling equipment, release agent formulations that will leave no trace of odor can be supplied on customer demand.

Readers' Service Item 1

Low viscosity epoxy for high temperature service

Mereco #43-21 is a low viscosity epoxy casting and impregnating system with long pot life and excellent adhesion to most materials, specifically designed for applications at temperatures up to 500°F., and is available from the Mereco Products Div., Metachem Resins Corp. It is supplied as a two-part system with a non-critical mixing ratio (one part activator to one part base); modifications can also be supplied. Some typical properties of the base resin, activator and a one to one mixture of resin and activator are given in the table below:

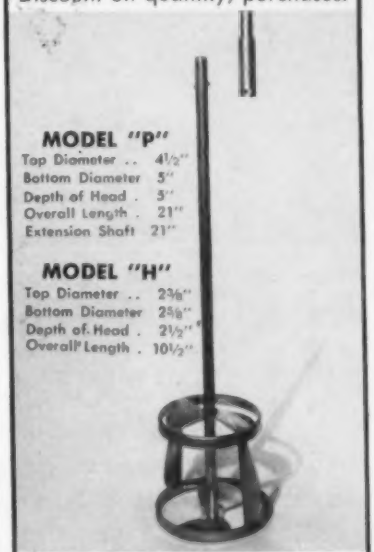
	Part A Activator	Part B Base resin	Mixture 1 to 1
Appearance, form	Clear liquid	Chalk colored syrup	Amber liquid
Specific gravity, 25°/25° C.	1.24	1.14	1.19
Viscosity, cps., 25° C.	450	5300	1090
Storage life, 77° F.	6 months	6 months	4-5 weeks

The vapor pressure of the Mereco 43-21 system is said to be practically nil, which is an advantage in insuring bubble-free castings. Working life and cure times are dependent upon the mass of material being prepared and the former is reduced somewhat for amounts as great as 50 lbs. For general purpose usage a cure of one to two hours at 150° followed by a post cure of two hours at 150°C. is recommended; to obtain maximum high temperature and electrical properties, three hours at 150°C. followed by five hours at 220°C. is suggested.

Some typical properties of fully cured Mereco 43-21 are as follows: Heat distortion temperature, 148°C.; Shore D hardness, 88; tensile strength, 11,400 psi; flexural and compressive strengths, both about 19,000 psi; water absorption (two hour boil) 0.45%; weight loss, 24 hrs. at 500°F., 1.8%, 200 hrs. at 400°F., 0.5%; dielectric constant, 10^3 cps., 3.18; power factor, 10^3 cps., 0.018; volume resistivity, ohm-cm., at 25°C., over 10^{16}, at 150°C., 3.0×10^{12}.

Readers' Service Item 2

Jiffy TRADE MARK
HI-SPEED MIXER
U. S. Pat. 2753162
The Patented
jiffy mixer
GUARANTEED
to Solve Your Mixing Problems
(Splash Proof)
(Will not suck in air)
Mixes with greatest ease:
Plastics, Chemicals,
Ceramics, Epoxies,
Paints, Putties,
and other liquid dispersions
Model "P" (shown) $15.95
for 5-30 gallon open containers
with extension $3.35 for
50 gallon containers.
Shafts fit ½" standard chuck.
Model "H" $2.95 for smaller jobs. Fits ¼" chuck.
Full satisfaction guaranteed
or full credit or money back.
Discount on quantity purchases.



MODEL "P"
Top Diameter .. 4½"
Bottom Diameter 5"
Depth of Head . 5"
Overall Length . 21"
Extension Shaft 21"
MODEL "H"
Top Diameter .. 2⅜"
Bottom Diameter 2⅜"
Depth of Head . 2½"
Overall Length . 10½"

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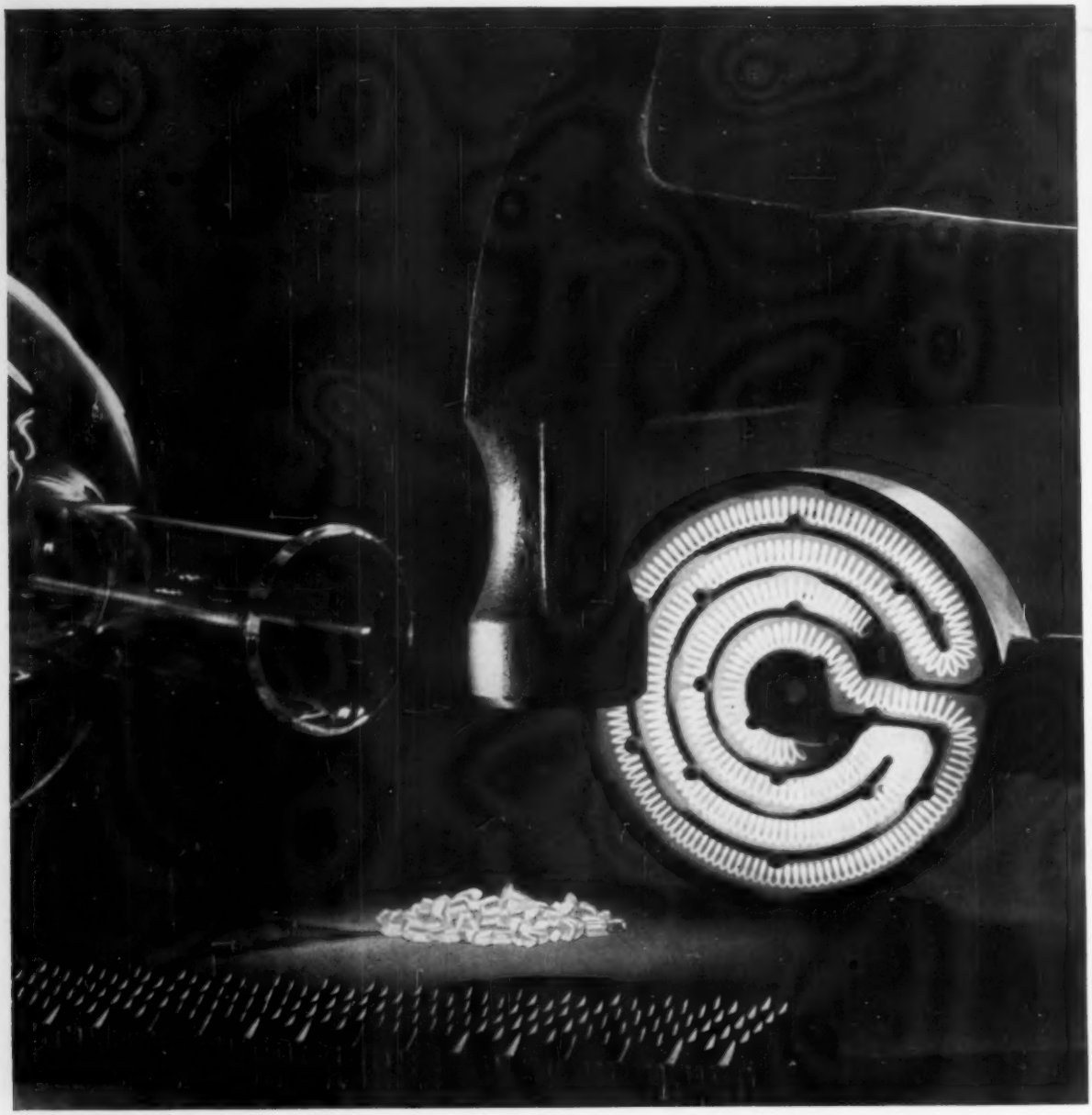


DOW POLYPROPYLENE

. . . with important plus values for designers and molders

An outstanding combination of properties—impact, chemical and abrasion resistance; high heat distortion temperatures; strength and stability; excellent dielectric properties. These, plus improved toughness and exceptional moldability, make Dow polypropylene the preferred plastic for fast, trouble-free processing of low-cost items—from mop heads to television cabinets. Be sure to check with Dow before you try any polypropylene. A call to your nearest Dow sales office will get you full details; or write for complete technical information to: Plastics Sales Department 1707DT11, Midland, Michigan.

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

For more information check Readers' Service Card No. 135

Improved solubility vinyl solution resins

Two new, high purity, medium molecular weight, vinyl chloride-vinyl acetate copolymer solution resins, Bakelite VYHD and VXCC, with high solubility characteristics for the preparation of product finishes and industrial maintenance coatings, are available from Union Carbide Plastics Co. VYGD is unmodified; VXCC is structurally modified to impart metal-adhesion properties.

Coupled with the good toughness, flexibility and chemical resistance of the coatings produced is the low viscosity of both resins in solutions of high solids content. VYHD and VXCC are more soluble in the vinyl resin dissolving ketones and other solvents, have higher aromatic tolerances, and yield lower viscosity solutions than other existing equal quality vinyl resins. Solvent costs can be reduced by increasing the non-volatile content of the formulation and increasing the ratio of lower-cost aromatic diluents to ketones and other higher-priced solvents, therefore, and 15 to 25% savings in applied resin costs can be achieved. For example, a 25% solution of VYHD/VXCC (8:3) in MEK has a No. 4 Ford Cup viscosity of only 30 seconds. If 65% of the solvent is replaced with toluene, the same 30 second viscosity is obtained at 22% solids.

The adhesion of VXCC to ferrous and non-ferrous metals, glass, paper, etc. is equivalent to that of Bakelite resin VMCH on air drying and baking. Air-dry adhesion of VYHD to bare metal is obtained by blending with VMCH or VXCC on a 1:1 or 4:1 ratio; otherwise, VYDH requires a minimum bake for good adhesion to metal.

Readers' Service Item 3

Versatile ethylene copolymer resin

"Poly-Eze," a new, easy processing ethylene copolymer resin with an unusual combination of desirable properties for injection and blow molded products and for extruded tubing, film and sheeting, has been annnounced by the Spencer Chemical Co. The resin has a density of 0.932 and a melt index of 2. Better flow characteristics than polyethylene at comparable melt index means that injection molding machine output with the new resin generally exceeds that of PE, according to Spencer. Articles blow molded from "Poly-Eze" are said to have much better flexibility, recovery and toughness than those made of polyethylene; film processing characteristics are similar to PE at about 25°F. lower temperature; and, good extrusion qualities at lower temperatures than PE are realized with tubing.

This ethylene copolymer has properties similar to those of low density polyethylene, plasticized vinyl and rubber. It has very good elasticity without the use of plasticizers and may be loaded up to 50% with low cost fillers with little effect of tensile strength and elongation. "Poly-Eze" closely resembles low density PE in appearance and properties but with improved low temperature flexibility, impact strength and resistance to stress-cracking over the latter. It blends well with other materials and is being evaluated as an additive to rubber and a number of other substances.

Impact strength of "Poly-Eze" film is said to be superior to that of PE and film from the new resin has excellent "hand" and drape, these properties indicating potential applications in draperies, shower curtains, tablecloths, tank liners, and in film applications where vinyl plasticizer migration is a problem. In injection molding, lower temperatures are required than with most polyethylenes and such products have rubber-like flexibility, good impact strength and superior resistance to stress-cracking. Extruded tubing is being evaluated in applications where "slip-fit" connections are being or could be used to provide cost savings

Readers' Service Item 4

Amorphous polypropylene

Eastman Chemical Products, Inc., is producing low molecular weight amorphous polypropylene in two grades; one, a tacky elastomer; and the other in the form similar to a moderately heavy grease. The elastomeric form stretches and is easily melted, both forms are sticky and compatible with a number of other resins and with most waxes and are soluble in most aromatic and aliphatic solvents.

Preliminary evaluations have shown both materials to have promise for use in hot-melt adhesive blends with a number of waxes and other resins for laminating and sealing and in caulking and potting compounds. The elastomeric type has imparted flexibility to olefin waxes and resins in many applications so far.

Some typical properties of these two grades of polypropylene follow:

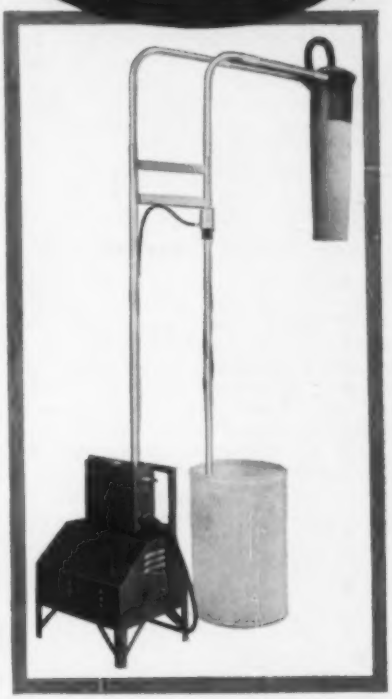
Properties	Elastomer	Grease
Density	0.82	0.79
Ring and ball softening point, °C	105	75
Color (liquid) Gardner scale	1	10
Acid number	0.1	0.1
Molecular weight	12,000	6,000
Brookfield viscosity, cps.		
120° C.	—	3,000
140° C.	140,000	1,400
160° C.	70,000	700

Readers' Service Item 5

Low cost slip additive

A highly purified nitrogenous aliphatic compound in the form of a dry, free-flowing powder called RAM, is available from Fine Organics, Inc. as a slip additive or release agent for polyethylene, polypropylene or polyvinyl chloride resins. The material is light in color (below 1 on FAC color scale), low in soap content (0.12% typical analysis), low in free fatty acid (1.0%), melts at 83-84.5°C., has

New VACUUM CONVEYOR PUTS ALL THE POWDER IN YOUR HOPPER!



Engineered for dust-free efficiency, the new Whitlock Model 400 Vacuum Conveyor moves over 1,200 lbs. of free-flowing powdered or granular material per hour—*automatically.*

Self-supporting, with power and control unit on floor, away from press if desired, vacuum hopper is placed over machine hopper, not on it.

Designed for easy cleaning, the Model 400 features an automatic blow-back for cleaning the filter after each loading cycle; plus a telescoping pick-up tube for fast drum changing.

For complete information on the new Whitlock Vacuum Conveyor write:

Whitlock

60-C

WHITLOCK ASSOCIATES INC.

21655 Coolidge Hwy. Oak Park 37, Mich.

For more information check Readers' Service Card No. 136

an iodine value in the range of 62-75, and loses only 1.9% by weight when held at 550°F. for 15 minutes. RAM meets the requirements of the Food and Drug Administration for materials that come in contact with food, and is available in commercial quantities at low cost.

RAM is of value in the lamination of polyethylene to cellophane and where elevated processing temperatures are required. With polypropylene a concentration of 0.1% is recommended for sheet extrusion, 0.125-0.150% as an aid in mold release in injection molding, up to 0.2% for use as an anti-staticizer. A concentration of 0.25-0.50% imparts excellent slip and anti-tack properties to vinyl film and sheeting. No plating-out of the additive was found after four months of shelf testing and the film remained clear with an attractive gloss.

Readers' Service Item 6

Tough, flexible polyester resin

Aropol Q-6030, a new fully flexible polyester resin with excellent toughness, tensile strength, and elongation properties, is available from Archer-Daniels-Midland Co. It is recommended for auto body solders, caulking and sealing compounds, gaskets, and as a laminating resin where toughness and flexibility are required.

The impact strength, vibration dampening characteristics, and low exothermic heat of Q-6030 make it very suitable for use also in potting and encapsulation of electronic components. It may be blended with other Aropol polyester resins to increase resilience and impact strength. Q-6030 is suitable also for marine and outdoor applications because of excellent water resistance.

Some properties of liquid Q-6030 and some of its curing characteristics are given below:

Properties of Liquid Q-6030

Styrene content, %	33–35
Viscosity, 77° F., cps.	430–450
Color, Gardner, max.	5
Lbs./gal.	9.4–9.5
Acid No.	12–16
Stability at 250° F.	4–6

Curing Characteristics—SPI Gel Data

Standard 180° F. Bath—1% Benzoyl Peroxide	
Gel time, mins.	16
Time to peak exotherm, mins.	24
Peak exotherm temp., °F.	330
Modified 250° F. Bath—1% Benzoyl Peroxide	
Gel time, mins.	2⅓
Time to peak exotherm	3.7
Peak exotherm temp., °F.	435

Readers' Service Item 7

Flexible casting compound

HYSOL Casting Compound C9-5041, using Hardener H4-3656, a flexible, flame-out casting compound originally designed for encapsulating transformers that are required to meet MIL-T-27A, Class S, Grades 2 and 5, has been developed by HYSOL Corp. The compound is suitable for module, capacitor, coil, resistor, and diode encapsulation as well.

The two-component heat cure system has a low working viscosity of 250 cps. when cast and cured at 85° C., a three-day pot life at room temperature; excellent electrical and physical properties; and is self-extinguishing. Some details of the uncured and cured material are given below:

Uncured Properties	5041	3656
Shelf life, months	6	6
Viscosity, Brookfield, 25° C., cps.	30,000	15,000
Cured Properties		
Density, lb./cu. in.	0.06	
Color	green	
Thermal shock (washer test)	passes	
Dissipation factor		
100 cps. at 30° C.	0.090	
100 cps. at 110° C.	0.150	
Dielectric constant		
100 cps. at 30° C.	5.40	
100 cps. at 110° C.	7.45	
Volume resistivity		
ohm-cm. at 30° C.	6.52×10^{13}	
ohm-cm. at 110° C.	3.22×10^{10}	

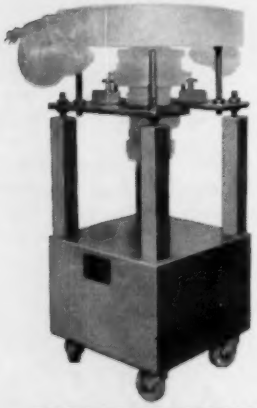
Mixing ratio by weight is 100 parts of C9-5041 to 125 parts of H4-3656

Readers' Service Item 8

JOHNSON ENGINEERED
Extrusion Accessory EQUIPMENT

EVERYTHING for Extrusion
EXCEPT THE EXTRUDER

BLOWN FILM DIE AND AIR RING STAND



SHEETING DIE STAND

POSITIVE CENTERING ADJUSTMENT FOR DIE

JOHNSON Portable Sheet Die, blown film die and air ring stands for safe and simple transport of dies to or from extruder . . . save times and eliminates costly damage. Stands are rigidly fabricated with heavy duty casters. Dies are securely fastened to stands with adjustments for height and centering.

ADDITIONAL INFORMATION AND PRICES ON REQUEST

JOHNSON MANUFACTURING CO., INC.
DEPT. 302 • CHIPPEWA FALLS, WISCONSIN • PHONE PA 3-2232

For more information check Readers' Service Card No. 137

For cleaner, faster quality compounding...

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The end products resulting from the combination of polystyrene or polystyrene scrap and Columbian's Costyreneblak are numerous. But more important is the fact that Costyreneblak is *clean*. Carbon black has been predispersed in chips that are relatively dustless. Result: hardly any clean-up time needed *and* a minimum chance of contamination.

You get *faster compounding* too: no pre-milling, fewer rejects. And with Costyreneblak, *you can save money*. Because it's a quality dispersion, you will use less of it. But get the full story by mailing off this handy coupon . . . today.

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For more information check Readers' Service Card No. 138

Product design can make this difference: of two products—identical in function, material and color—one sells, the other stays on the shelf. Product design is one of the ten major services available to Grace customers as part of the Grace Service Plan. Your Grace representative can give you details on that extra touch of Grace.

W. R. GRACE & CO. POLYMER CHEMICALS DIVISION, CLIFTON, N. J.

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GRACE PLASTICS

For more information check Readers' Service Card No. 139

New PE wire insulation

Bakelite DFD-0745 Blk 9845, a new low-density polyethylene extrusion compound with exceptionally high stress-cracking resistance for line wire service, drop cable, and other applications requiring such properties is now commercially available from Union Carbide Plastics Co. The new compound is stabilized for weatherability by the addition of carbon black and tests show that aging results in little loss of tensile properties.

In stress-cracking tests, where other line wire insulating materials failed as early as 48 hours in "Igepal" CO-630 and one hour in "Hostapal" HL, DFD-0745 Blk 9845 went 2000 and 500 hours, respectively, before initial failure.

With a tensile strength of 2300 psi, elongation of 600%, and a brittle temperature of —85°F., DFD-0745 provides a wire covering that will stand up under rough handling and environment. Deformation is zero at 105°C. and only 15% at 110°C., temperatures much higher than are likely to be encountered in use.

The outstanding electrical properties of DFD-0745 reduces outages due to accidental grounding from contact with trees, branches or foreign objects across the lines. Because of thinner, smoother coatings that can be applied with DFD-0745, handling is easier, reels hold more wire, and span load between poles is decreased.

The new compound has a density of 0.93 and a melt index of 0.3 and extrudes as readily as general purpose, low density polyethylenes with a compound temperature of 400°F. at the die. Some further results of electrical and mechanical tests with DFD-0745 follows:

Dielectric strength, short time, volts/mil, (125 mil spec.)	500
Dissipation factor, dry, at 23° C.	0.004
Dielectric constant, dry, at 23° C.	2.55
Tensile strength, psi.	2,300
Elongation, %	600
Stiffness in torsion, psi, at	
25° C.	25,000
0° C.	43,000
−25° C.	120,000
−50° C.	245,000
Brittle temp., F_{50}, °C.	−85

Readers' Service Item 9

Also worth mentioning—

☐ Araldite DP-125, a low viscosity, modified polyamine hardener available from Ciba Products Corp. for curing at room or elevated temperatures. Araldite DP-437 flexible epoxy resin or blends of DP-437 and other liquid epoxy resins. The initial viscosity of the resin-hardener mix is only 1,000 to 1,500 cps. Similar end properties result from systems cured at room temperature or 100°C. The cured material has excellent elongation and good tensile strength and excellent resistance to age hardening (no change after 90 days at room temperature).

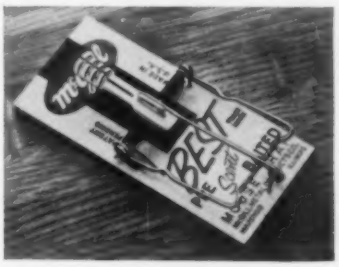
Readers' Service Item 10

TENITE DEVELOPMENT LABORATORY DOINGS AND FINDINGS

A BETTER MOUSE TRAP

Correspondents on the man-versus-mouse front tell us of a new trap calculated to lure man's ancient foe straight to doom. No bait required. The attraction is the trap's special trigger, treated with a scent that apparently wafts forth powerful mouse-appeal.

The trap manufacturer uses tough Tenite Butyrate plastic for the trigger and adds the scent—his own highly researched, secret formula—during molding. For the sake of skeptics, human or rodent, the molded trigger design includes a holder for bits of cheese or bacon. But so irresistible is the prescented trigger itself, we are told, that shipping cartons for the traps have actually had to be treated with a mouse-repellent. Such are the wonders of modern chemistry.



And speaking of wonders . . . packaging the traps in new bags made from film of Tenite Polyethylene appears to remove a psychological barrier for women shoppers. Normally reluctant to touch even a new mouse trap, the ladies reportedly pick up the packaged traps with scarce a qualm.

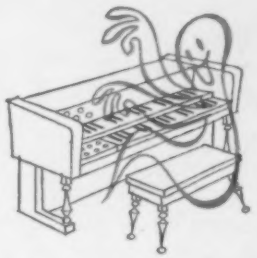
Tenite Butyrate and Tenite Polyethylene are highly adaptable to unusual, as well as conventional, product needs. For technical details and advice on processing these versatile materials, contact your nearest Tenite sales representative or write to EASTMAN CHEMICAL PRODUCTS, INC., *Plastics Division,* KINGSPORT, TENNESSEE.

MORE ON THE COPPER DISH TEST . . .

Last DOINGS AND FINDINGS, we told you how pure Tenite Polypropylene is — 99.99% before special additives — and we explained that this purity resulted in a high resistance to oxidation. We even described the copper dish test which produced the results on which we based our claim to great resistance against oxidation for Tenite Polypropylene. This test, we neglected to add, was contributed to the plastics industry by Bell Telephone Laboratories. It is only one of the many ways in which Bell has helped the industry select suitable antioxidants for polyolefins. The copper dish test is, in our opinion, a great test. Try it . . . with Tenite Polypropylene.

THE QUIET WORLD OF RESEARCH

An electric organ has been playing day and night for over two years, but



not a single note has been heard. A television set turns itself on each morning at 8:00 A.M., plays for 12 hours, and then turns itself off.

These ghostly goings on in the research laboratories at Kingsport have been arranged to test the electrical stability of film made from Eastman's new Tenite Polyester.

The organ contains fifty uncased capacitors wound with this film. They range from 0.001 to 0.025 microfarads and are part of a resonant circuit that produces pitch by creating and subdividing a basic frequency of 2,500 cycles per second. Over an 8-month interval of continuous operation, the basic frequency varied by no more than eight cycles per second—indicating unusually high electrical stability.

(Since the circuit is tested electronically, there is no need for an amplifier. Consequently, the organ remains mute.)

Our robot television set contains 20 uncased capacitors wound with film of Tenite Polyester. Over the past two years, tubes have blown and potentiometers have burned out, but not a single capacitor has failed.

Supplementing the "in use" data, accelerated aging tests have also been run. Results indicate that 4 out of 5 uncased capacitors made from film of Tenite Polyester will function at 140°C. and 400 volts per mil for as long as five years.

The great durability of Tenite Polyester plastic is due primarily to its resistance to humidity. Even after 21 days of testing at 100% relative humidity and 110°C., the uncased capacitors remain intact and can be handled without special care.

Note the word **uncased.** The properties demonstrated by these tests mean substantial savings in making capacitors . . . they eliminate the need for casing. In a conventional capacitor, the case represents a major part of cost.

Film from Tenite Polyester is manufactured and marketed by Terafilm Corporation under the trademark "Terafilm." For more information about its properties and uses, write to Terafilm Corporation, Canal and Ludlow Streets, Stamford, Conn.

TENITE®

plastics by Eastman

For more information check Readers' Service Card No. 140

UP a Crazy River in a GLIDPOL® Hull

Some daredevils have tried to pilot boats *down* the raging Colorado River through Grand Canyon . . . a few lucky ones have succeeded. But not even the foolhardy would think of going *up* this crazy river—until recently.

The builders of Turbocraft jet-powered boats succeeded in making the first up-river transit of the Colorado, and their GLIDPOL resin glass fiber hulls came through with flying colors . . . and only a few rock-punched holes that were readily patched. GLIDPOL resin helped provide the strength needed for the drive of jet engines against the Colorado's rapids and rocks.

Whatever your plastic-reinforced product is, it will be better, stronger, more saleable when made from one of the family of Glidden GLIDPOL polyester resins . . . the resins that went UP the Colorado by jet!

QUALITY Glidden PRODUCTS

RESINS FOR EVERY APPLICATION

The Glidden Company
INDUSTRIAL PAINT DIVISION
900 Union Commerce Building • Cleveland 14, Ohio
In Canada: The Glidden Company, Ltd., Toronto, Ontario

There's a GLIDPOL polyester resin system, plus Glidden Technical Service, to help you do it better, more economically, whatever your product, process or problems.

For more information check Readers' Service Card No. 141

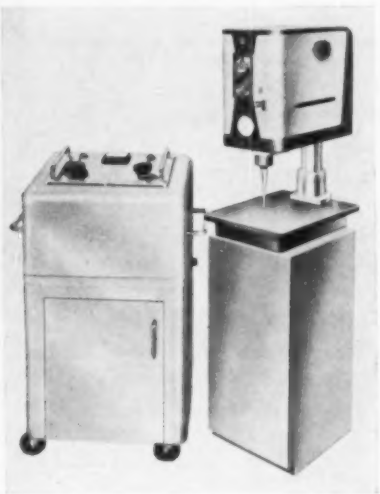
New Equipment

Ultrasonic sealer

The Zephyr 300 ultrasonic sealer for welding plastic film without adhesives, chemicals or high voltage, has been announced by Ultra Sonic Seal, Inc., subsidiary of Kleer-Vu Industries, Inc. It can cut or seal, and makes butt, lap, seam, spot, or continuous welds of polyvinyl, polyester, polyethylene, polypropylene, nylon and other plastic films.

In operation, two pieces of plastic are sandwiched between a solid anvil and a continuously hammering tool. The latter moving at a minimum rate of 20,000 blows per second, produces a natural molecular bond without deforming, distorting or changing the properties of the material.

A head section, containing the resonant transducer and operating tool, is 23 inches high by 10$\frac{7}{16}$ inches wide by 18½ inches deep. It is mounted on an adjustable base which may be used as an anvil. The transducer, suspended within the head section, moves perpendicular to the material being bonded. Vertical pressure is adjustable, and a dial gage indicates vertical movement.

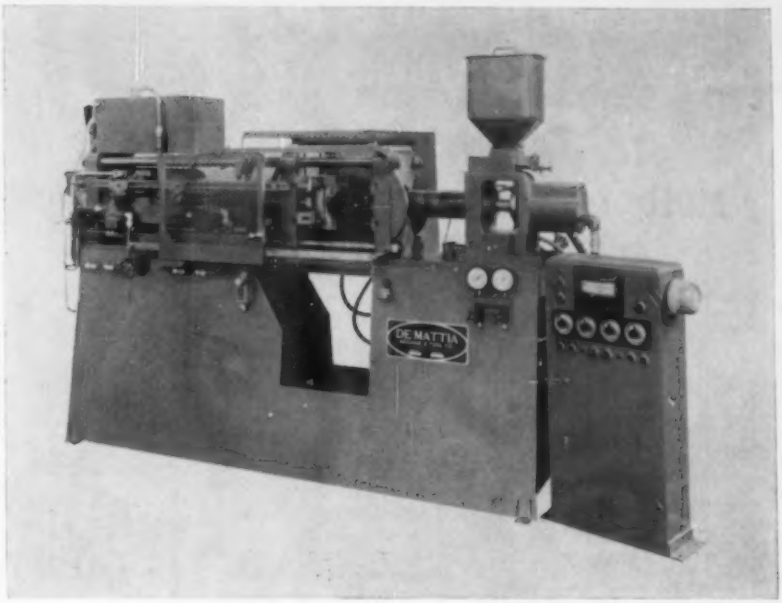


Zephyr 300 ultrasonic sealer for plastics.

The driver unit houses a 25 kc power generator and associated control panel. This unit is 36½ inches high by 24 inches wide by 17 inches deep and weighs about 200 pounds. The electrical pulse generated in this unit is converted to mechanical energy, which performs the welding operation.

Featuring low power consumption, the sealer will bond film from ¼ to 40 mils in thickness at speeds up to 100 feet per minute.

Readers' Service Item 21



DeMattia 2-ounce automatic injection molder.

Fast two ounce fully hydraulic and automatic injection molder

The Model J 2-ounce, fully hydraulic, fully automatic injection molding machine recently announced by DeMattia Machine & Tool Co. is said to be the fastest machine of its type ever built. With panel mounted valves and a separate control cabinet, a floor space of 48 by 132 inches is all that is required for this 4500 pound machine.

The Model J has a plasticizing capacity of 50 lbs./hr., maximum daylight opening of 18 inches, clamping pressure of 56½ tons and a maximum mold plate size of 12 by 15 inches horizontal and 8 by 18 inches vertical. It has a dry run capacity of 20 shots per minute. These and other specifications are included in the listing below:

Model J injection molding machine

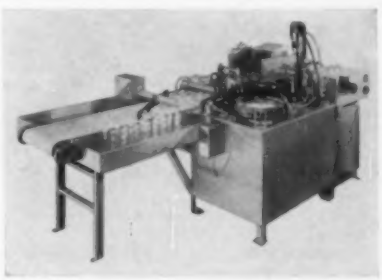
Capacity, oz.	2
Clamp, tons	56½
Stroke, inches	12
Daylight opening, inches	18
Max. mold plate, inches	
Horizontal	12 × 15
Vertical	8 × 18
Min. mold thickness, inches	6
Injection piston diam., inches	2
Pressure on material, psi	14,000
Plasticizing capacity, lbs./hr.	50
Dry run, shots/min.	20
Line pressure, psi	2,000
Motor hp.	15

Readers' Service Item 22

Surface oxidizing unit

The Lectro-Treat machine for preparing plastic surfaces for printing, silk screening, or labeling has been introduced by the Lectro-Treat Co. This equipment produces sufficient oxidation of the plastic surfaces of objects of all shapes and sizes such as bottles, vials, and novelties so that proper adhesion of inks and glues is obtained. Costs are said to be substantially lower than those for the flame treating or lacquer coating methods now in general use.

The machine is approximately six feet long by 30 inches wide and four feet high. It can be incorporated into a conveyor line and adjusted to the existing production rate. The oxidizing unit operates on 110 volt current at eight amperes, and can be precisely regulated while being clean and safe.

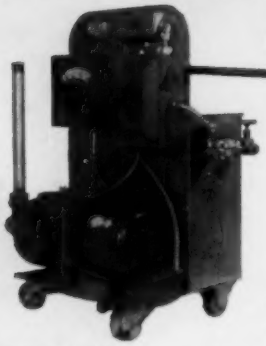


Machine for treating plastic surfaces.

Readers' Service Item 23

For more information check Readers' Service Card (p. 121)

INJECTION MOLDERS!
NOW YOU CAN AFFORD
AUTOMATIC
MOLD TEMPERATURE CONTROL



AT LOW COST
- COMPACT-SIMPLE
- ACCURATE MOLD TEMPERATURE CONTROL ±1°F
- TOP PERFORMANCE
- MINIMUM MAINTENANCE

If your mold heat climbs, the IMS Automatic Circulator takes heat away. If your mold heat drops, heat is automatically turned on. Positive control without operator attention at lowest cost!

Parts list, wiring diagram and instructions available on request.

PRICE: Complete ---------- $585.00
220 volt; 60 cycle; 1 phase only
SHIPPED FROM STOCK ORDER TODAY!

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For more information check Readers' Service Card No. 142

Egan

BLOWN TUBING DIES UP TO 80" DIAMETER

Shown above is a 72" thin wall tubing die.

A complete line of Egan Extruders from 2" through 12" and Accessories are available . . . Write for Illustrated Material.

FRANK W. EGAN & COMPANY
SOMERVILLE, N. J.

For more information check Readers' Service Card No. 143

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50 to 65% LESS MONEY FOR FINEST QUALITY THERMOCOUPLES

THERMOCOUPLES FOR PLASTICS INDUSTRY

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Never before such prices for Thermocouples and Assemblies! We're hearing this from hundreds of amazed new purchasers every month. Now, Glesco Electronics offers you a complete line of standard units and all kinds of specials at up to 2/3 less than you pay elsewhere.

Glesco's price reductions are achieved by new methods of Thermocouple construction which save time and production costs . . . money that's passed on to you.

But there's absolutely no sacrifice in quality. Our Thermocouples and Assemblies are precision-made from the finest materials used in the industry and are guaranteed to meet your highest standards of quality and craftsmanship.

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Write Now! A local McKesson & Robbins Chemical Department representative will be pleased to call and talk over your Organic Peroxide requirements.

For more information check Readers' Service Card No. 145

4½-inch extruder

Olympia Tool and Machine Co. has announced a 4½ inch, 24:1 L/D ratio extruder with a 42-inch center line. It is equipped with an Xaloy one-piece cylinder construction with no intermediate joints or flanges; an extra heavy thrust assembly; a continuous forced filtered oil system; a flexible coupling between gear transmission and thrust bearing assembly that eliminates thermal misalignment; a high grade Meehanite casting with tangential feed opening, water jacketed to prevent bridging in the throat; and a herringbone gear reducer for maximum power transmission.

Readers' Service Item 24

Hot-cold test chamber

A hot-cold chamber for use with tensile testers and vibrators has been added to the line of environmental test chambers made by Development Engineering Co., Inc. The chamber has penetrations for specimen holders so that testing may be done from —100°F. to 500°F., and is available with various types of instrumentation and controls from an inexpensive thermostat to a program recorder-controller. Humidity attachment is also available, as are windows, interior lights, electrical penetrations, etc. The chambers can be furnished either with hoisting hooks or mounted on a lift dolly.

Readers' Service Item 25

Rpm counter-controller

Series 312 Atcotrol shaft-driven revolution counter developed by Automatic Timing & Controls, Inc. provides dependable electrical control for machine or process equipment operation. Directly coupled to a rotating shaft, it may be driven at any speed (constant or variable) up to 2000 rpm with repeat count accuracy ¼ of 1% of dial range and is available in 11 standard dial ranges from 0-12 to 0-6000 revolutions with special ranged available on demand.

For process, batch system, or automatic flow control, the counter can be wired directly to control valves, pumps, agitators, etc. Pointer is set to count desired, start button is pushed and counter accurately measures required quantity and then shuts off automatically. Pointer resets and is ready for repeat.

Readers' Service Item 26

Low cost mold chiller

A low cost, 2-HP mold chiller with an 18,850 BTU rating is available from Injection Molders Supply Co., Inc. Designed specifically for circulating alcohol type antifreeze to injection molds, the chiller is caster-mounted and features the extra coil area necessary for injection plant use.

ANTIMONY OXIDE

HARSHAW HAS ALL GRADES AVAILABLE FOR IMMEDIATE SHIPMENT

KR Grade Pigment Quality High Tinting Strength

HARSHAW

KRLTS Grade Pigment Quality Low Tinting Strength

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Los Angeles 22, Calif. • Philadelphia 48, Pa. • Pittsburgh 22, Pa.

For more information check Readers' Service Card No. 146

Have You Seen BIPEL?
Smart American molders have seen . . . and installed . . . BIPEL equipment. They wanted these Compression-Transfer Presses for greater production, economy and dependability . . . fully or semi-automatic, or manual control . . . a wide choice of capacities up to 660 tons. And BIPEL Preformers, too, to get better preforms, faster, with controlled hydraulic action!
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RALPH B. SYMONS ASSOC., INC.
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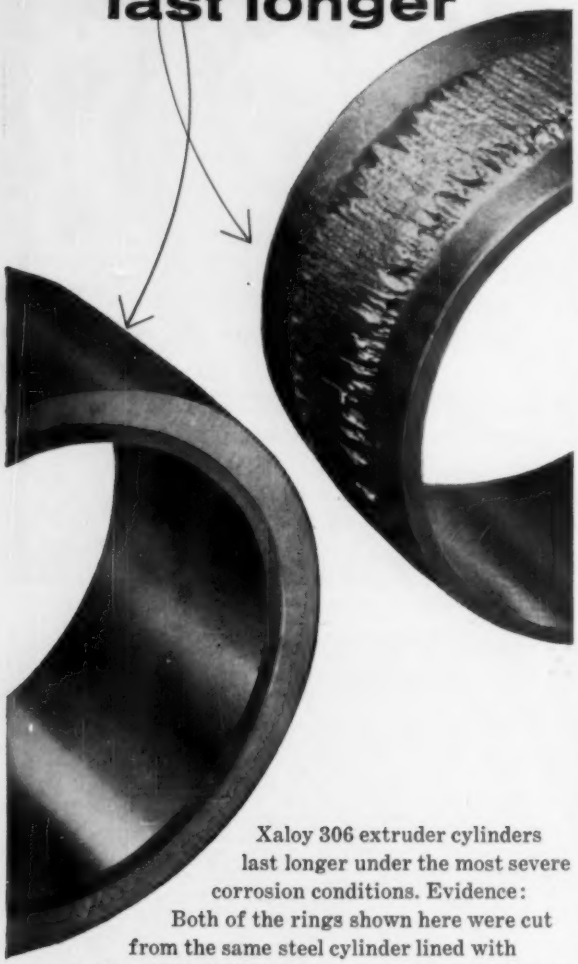
Proof that Xaloy 306 liners last longer



Xaloy 306 extruder cylinders last longer under the most severe corrosion conditions. Evidence: Both of the rings shown here were cut from the same steel cylinder lined with XALOY-306. At left is section of original cylinder with XALOY-306 lining. At right is section from same tube after immersion in boiling 50% hydrochloric acid. Note that Xaloy-306 lining is unaffected while steel backing has almost completely dissolved.

Write for Xaloy and Xaloy-306 Engineering Data Guide

BIMETALLIC Xaloy 306 CORROSION RESISTANT

BIMETALLIC Xaloy CORROSION RESISTANT

INDUSTRIAL RESEARCH LABORATORIES

MAIN PLANT: 961 East Slauson Avenue Los Angeles 11, California

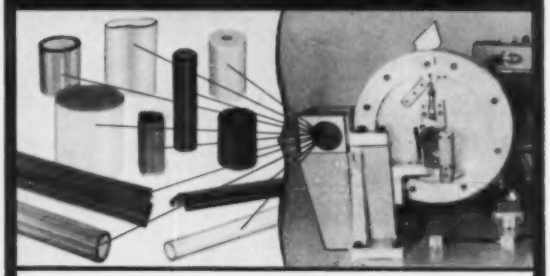
EASTERN BRANCH: 3 Terminal Road New Brunswick, New Jersey

FOREIGN LICENSEES in Europe, Australia, New Zealand, Japan and South America

For more information check Readers' Service Card No. 148

EXTRUSIONS CUT

ANY SHAPE, LENGTH, WALL THICKNESS



AT HIGH SPEED WITH PRECISION, ECONOMY BY VERSA CUTTER

5 MODELS TO MEET most requirements up to 4¾" diameter. Synchronized VERSA FEEDS. Automatic Control. Dependable. Built for 24-hour service. Write for complete specifications for your application. Send pieces of your extrusions for sample cut.

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For more information check Readers' Service Card No. 149

Such strength of reinforcement.

Such uniformity of weight, weave and thickness.

Such a wide variety to meet any particular need.

FLIGHTEX GLASS CLOTH

AND TAPES

FOR THE REINFORCEMENT of PLASTICS

Staple style... or a fabric to your specific needs. Whatever your requirements, you'll find the right glass cloth at FLIGHTEX.

Service... plus quality... plus dependability... no wonder more and more glass cloth users call FLIGHTEX their favorite source of supply.

Write for your Specification Guide.

FLIGHTEX FABRICS INC.

93 Worth Street • New York 13, N. Y.

For more information check Readers' Service Card No. 150

Other features are fan-cooled condenser, sealed compressor, and seamless coil.

Both the 2-HP compressor unit and the ¼-HP circulating pump (20 gpm. at 23 foot head) operate only on 220 volt, 60 cycle, single phase current. The chiller is 36 inches long by 30½ inches deep by 36 inches high, and has a tank capacity of about 15 gallons. It has an adjustable thermostat and a four-inch dial thermometer with a 0 to 200°F. range. In use, the chiller provides a closed circuit to the injection mold.

Readers' Service Item 27

Also Worth Mentioning

☐ A mixer for plastic materials from low to high viscosity in the form of a 5-6 gallon can which rotates while the removable agitator arm remains stationary is available from the Plaster Supply House. Suitable for use with epoxies, polyesters, polyamides, as well as with gypsum cements and mold making plasters, the mixer can rotate at 60 rpm in thoroughly mixing up to 70 pounds of material in two to three minutes. A vacuum adapter accessory removes air bubbles after mixing.

Readers' Service Item 28

☐ A new line of low cost Reel-Wynders and winder drives for providing controlled tension for winding foil, plastics, paper, textiles, wire and cable, film and filaments, metal, tape tubing, laminations, extrusions, etc., has been announced by Fluid Drive Engineering Co. Five standard sizes provide winding speeds from 3.5 to 3500 rpm, with output ratings from 1/16th through 3 hp. Design features include a proven fluid drive which automatically delivers increasing torque and tapered tension over core ratios as high as 8:1, while process speed may vary from 3:1; two simple controls provide a wide range of adjustable tensions and speeds; sturdy construction and easy accessibility minimize maintenance; large air cooling fins and high-speed rotation assure cool operation; and low inertia driven members coupled with hydraulic cushioning, reduce shock and acceleration stresses to a minimum.

Readers' Service Item 29

☐ The Turvort gun, which incorporates a new unit for mixing and dispensing reactive resins and hardeners into a gun weighing less than one pound, has been developed by Leal Corp., for handling urethane foam materials, liquid epoxy and polyester resins and many other materials. The gun when fed from a metering system mixes and dispenses reactive resins and, when equipped with proper spray tips, can do airless spraying of multicomponent resin materials. The Leal Corp. makes metering equipment which is used with the Turvort gun to make a complete spraying and dispensing system.

Readers' Service Item 30

LATENT CURING AGENT FOR EPOXY RESINS

HARSHAW BORON FLUORIDE MONOETHYLAMINE COMPLEX

Physical properties:

White to pale tan flake • Very hygroscopic

Soluble in polyglycols, acetone, methy ethyl ketone, and furfuryl alcohol

Freezing range—88-90°C

Bulking density—6.2 lb./gal.

Other BF_3 Complexes are available. Write for details.

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For more information check Readers' Service Card No. 151

Increase COLOR CODING OUTPUT with the Model 1250-20 Long Barrel VERTICAL EXTRUDER

SIMULTANEOUS EXTRUSION OF DIFFERENT COLOR MATERIALS for:

- *Striping Identification*
- *Color Coating*
- *Wire Insulation*

20:1 L/D Ratio
30-40 lbs./HR
Nominal Output

We will make the dies to meet your specific requirements. Let us know your extrusion problem. We will solve it at no additional cost.

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Thermoplastic Equipment Corporation

Div. of Thermoplastic Processes, Inc.

VALLEY ROAD • STIRLING, N. J.

Millington 7-1000
Mitchell 3-4600
COrtland 7-6220

Write for Catalog and Complete Information

For more information check Readers' Service Card No. 152

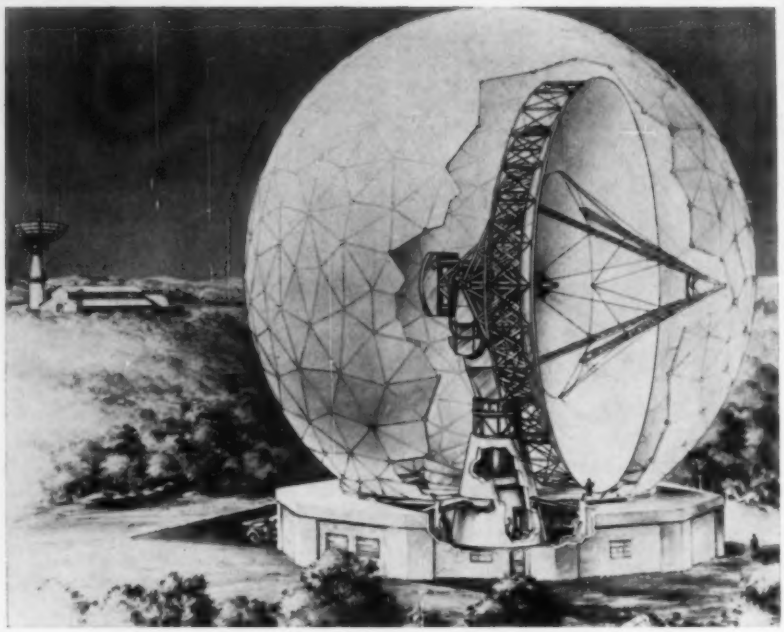
Plastic Applications

Glass reinforced polyester for large spherical radome

Glass fiber reinforced plastic triangles, 1/32 of an inch thick, made of fire-retardant Hetron polyester resin of the Durez Plastics Division, Hooker Chemical Corp., are being used in the construction of a new type spherical radome 150 feet in diameter by H. I. Thompson Fiber Glass Co. The radome will provide protection from the weather for the quarter-acre reflector surface on a 120-foot wide saucer-shaped antenna to be employed in radio communications research by the U. S. Air Force at a new facility under construction at Tyngsboro, Mass.

The 930 glass fiber-reinforced polyester plastic triangles are mounted on a hollow aluminum framework made of extruded beams up to 15 feet in length. The plastic triangles are connected in a carefully-planned "random pattern" to avoid interference with radio beams. The huge sphere is capable of withstanding winds up to 130 miles per hour and moderating solar heat which otherwise might distort the antenna's reflector surface beyond the allowable minum of 0.075 of an inch. The plastic triangles are said to possess excellent electronic transparency, an important property for electrical performance at UHF frequencies.

Construction of the $3.8 million research facility, scheduled to be "on the air" by late 1962 is being managed by the Electronics Systems Division at Hanscom Field, Mass., one of the four divisions of the Air Force Systems Command.



Glass fiber reinforced polyester used in new radome.

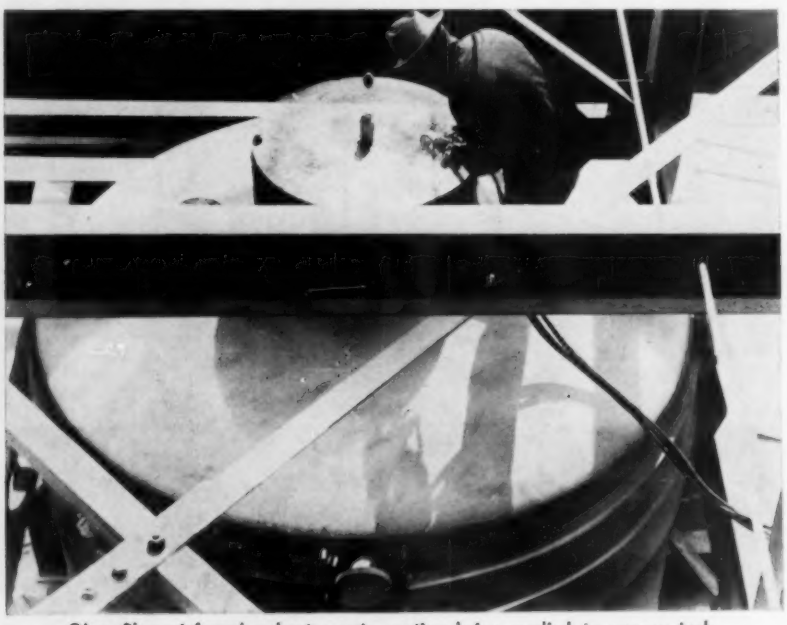
Readers' Service Item 41

Sprayed-on glass-reinforced polyester process tank coat

Chemical Fire & Rust Proofing Corporation achieved substantial savings in corrosion-proofing the outside of large chlorine dioxide reactors of the Bowaters Carolina Corp. against destruction by spillage by spray-coating this equipment with glass fiber-reinforced polyester resin (Atlac 382 of Atlas Powder Co.). By using the spraying technique, the project was completed in approximately 50% less time than hand layup work with glass fabric or ceramic tile application would have required.

After sandblasting the carbon steel tank surface, all three components comprising the coating—resin, promotor, and chopped glass fiber roving—were then applied in thicknesses from 1/16 to 1/8 of an inch, according to the protection required, in a single spraying operation. The continuous, homogeneous coating of reinforced resins adhered tightly to the vessel surface and provided a smooth, unbroken film, more impervious to corrosion than more expensive materials such as ceramic tile. Another advantage of the spray technique is its ability to provide a uniform coating even in irregular and inaccessible areas where a layup coat is difficult or impossible to apply.

According to extrapolations based on recent long-term immersion tests at elevated temperatures, the sprayed-on glass fiber reinforced polyester coating is expected to hold up for at least 10 years.



Glass fiber-reinforced polyester resin coating being applied to process tank.

Readers' Service Item 42

For more information check Readers' Service Card (p. 121)
For more information check Readers' Service Card No. 153➔

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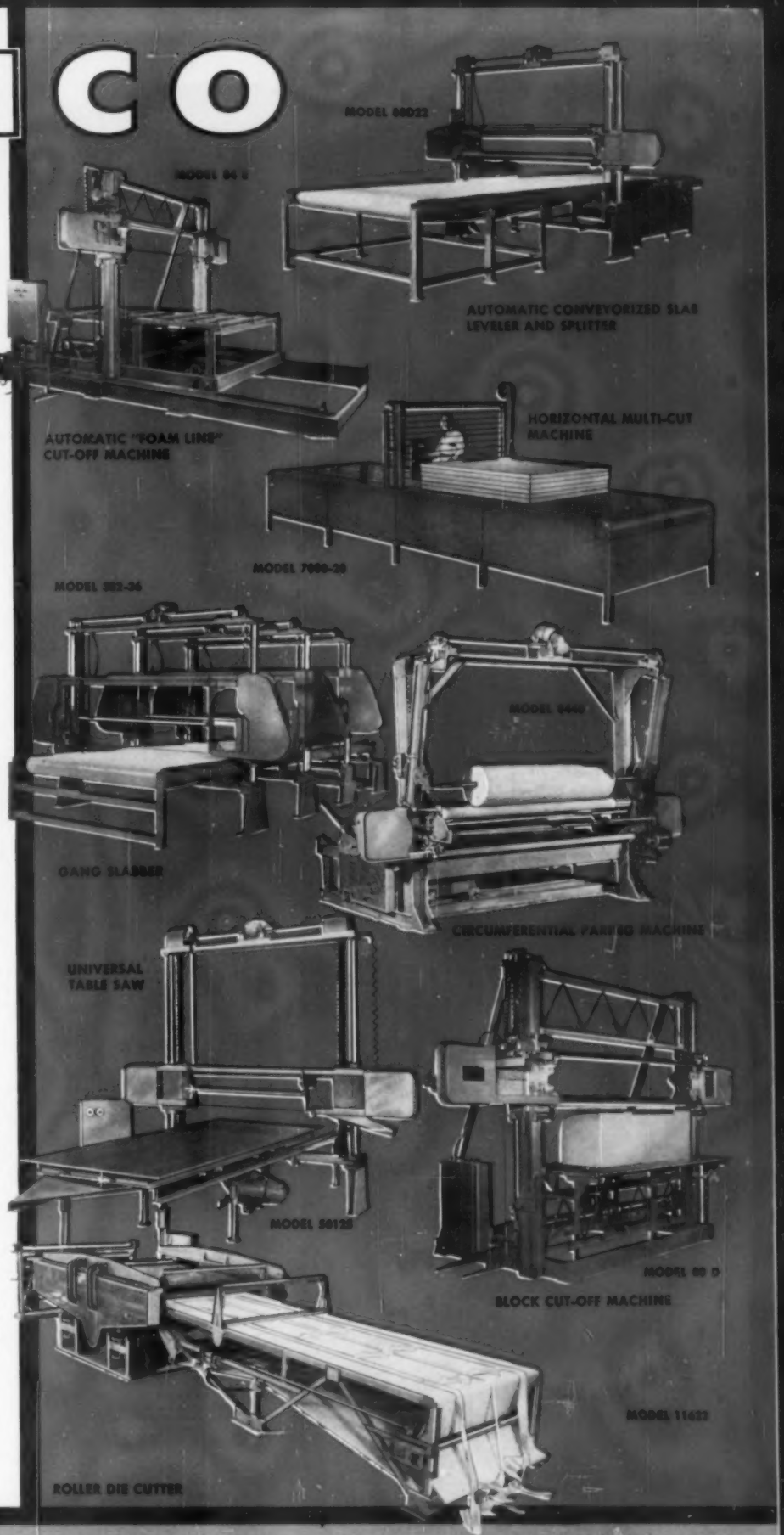
ONE RESPONSIBILITY

1. **AUTOMATIC CONVEYORIZED SLAB LEVELER AND SPLITTER**—Splits foam slabs 80" wide x 40" thick and up to 40' long into sheets as thin as 1/16". Completely automatic.
2. **AUTOMATIC "FOAM LINE" CUT-OFF MACHINE**—Positioned at end of foaming line to automatically cut blocks of foam to required lengths. Cuts blocks 48" thick x 84" wide x 50' long.
3. **HORIZONTAL MULTI-CUT MACHINE**—Makes as many as 18 horizontal hot wire cuts through a block of foam simultaneously. Foam blocks up to 10' long x 80" wide x 36" high can be cut.
4. **GANG SLABBER**—Splitting heads mounted in series over power driven conveyor make it possible to fabricate entire block of foam into slabs simultaneously with this machine.
5. **CIRCUMFERENTIAL PARING MACHINE** — Pares a log of foam 84" wide x 40" in diameter into a continuous sheet for laminating. Stock can be pared as thin as 1/32". Cutting speed from one to 320 FPM.
6. **UNIVERSAL TABLE SAW** — Made for fabricating rigid foam blocks into sheets as thin as 1/4". Will handle stock 50" wide x 125" long and 42" thick. Completely automatic.
7. **BLOCK CUT-OFF MACHINE** — Cuts foam blocks up to 80" wide and 42" thick. Available with feed and discharge conveyors.
8. **ROLLER DIE CUTTER**—Uses inexpensive steel rule dies to cut specific shapes from sheet or roll stock. Fully automatic. Available in variety of sizes with vertical or horizontal die handlers.



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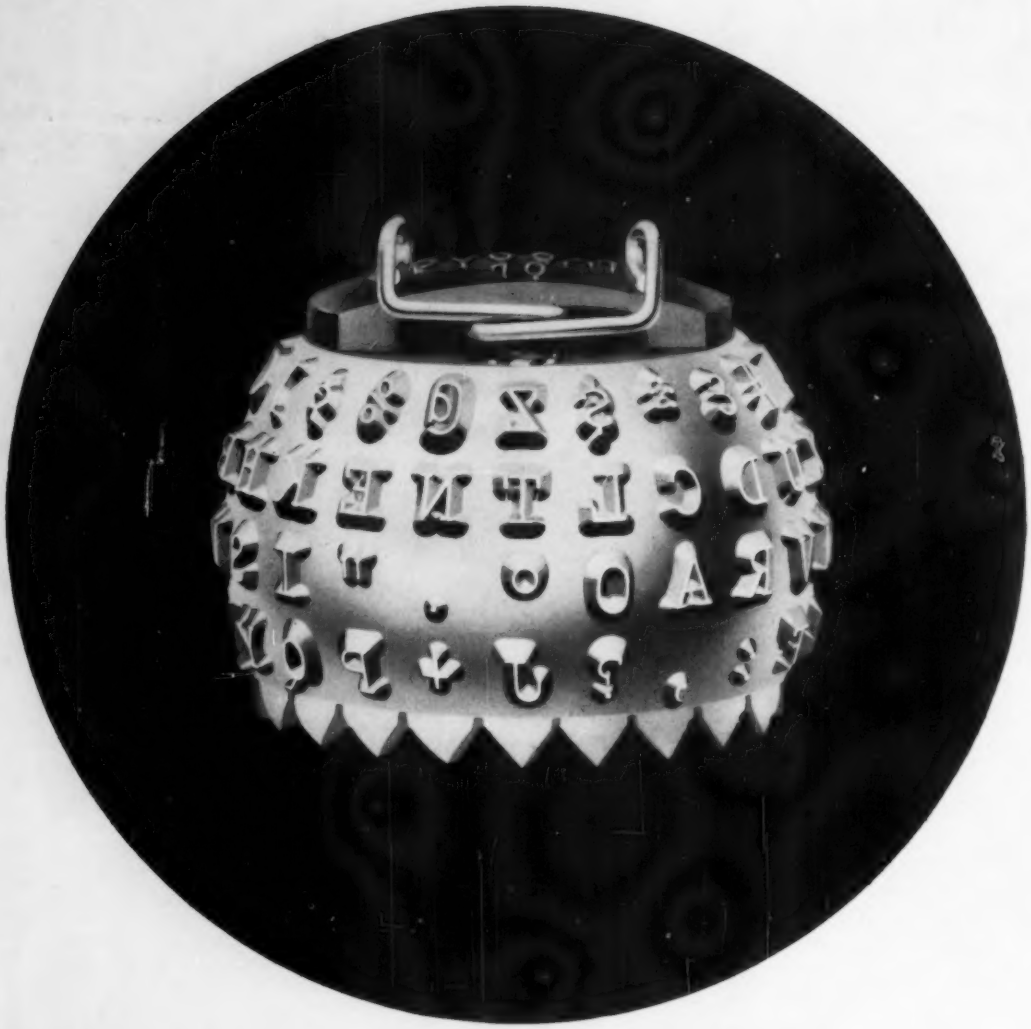


Plaskon UREA...ENABLES IBM TO MOLD A NEW WAY TO WRITE

The precision engineered typing element of IBM's new Selectric® carriageless typewriter is molded of PLASKON® UREA.

No bigger than a golf ball, this nickel-plated urea sphere does the work of a basketful of type bars—tilting and rotating at high speed as it selects and types the desired character or symbol.

According to IBM, many materials were checked for impact strength, resistance to acids, shrinkage and adaptability to molding. Plaskon Urea was the choice: It was selected because it has the best combination of those properties required.

Plastics Division offers complete research and technical assistance to help you with your design and molding problems.

PLASTICS DIVISION
40 Rector Street, New York 6 N. Y.

Allied Chemical

BASIC TO AMERICA'S PROGRESS

For more information check Readers' Service Card No. 154

New packaging technique for electric instruments

High density polyethylene plastic caps of special design for either side or end of a switchboard instrument are the basis of a new protective packaging technique developed by the Westinghouse Electric Corporation's meter division to protect the instrument against all hazards of handling, transportation, storage and climatic conditions.

Using a formed plastic cap at either side or end of the switchboard instrument to be packaged, the unit is held in suspension within the caps and positioned securely by pressure at both ends and all four sides. The design of the plastic caps allows the switchboard instrument to be encapsulated in the enclosure by a method of forming the plastic to conform to the outer ends of the apparatus. For commercial use the apparatus will be partially encapsulated as shown on the right in the accompanying photograph or it may be completely encapsulated when required by military specifications as shown on the left in the photograph. The polyethylene package can be sealed to conform with the most rigid specifications involving moisture or vapor barrier packaging protection.

Military pack (left), cutaway of commercial pack (right), stack of nested caps (right center), and simplicity of new packaging operation (center)

High density polyethylene was found to be an almost perfect packaging material for this application in that it was clean and dust free, nonabrasive, noncorrosive, sealable against climatic hazards, lighweight, high in tensile strength, and capable of being nested in the form of the plastic caps to achieve the required small amount of space for storage in the "knocked-down" form. The high density polyethylene did not provide the cushioning, shock, impact, or vibration protection required, however, until it was designed into end caps with a series of formed, concentric, continuously extending sections.

Among the many advantages of this new packaging technique are a reduction in the storage area required for packaging materials and in that required for packaging operations, a reduction in packaging labor and material costs up to 50%, a reduction in inbound cost of packaging materials because of density in nesting the formed materials, a reduction in transportation costs up to 40%, a reduction in the cubic space required for company and customer warehouses, and a reduction in the cubic space required in the transportation vehicle up to 80%.

The new technique is being used commercially to package certain types of Westinghouse instruments and relays with more applications to follow. Also, the polyethylene is so constructed and designed that it lends itself to mechanized packaging in the assembly line on high-volume items.

Readers' Service Item 43

Fluorocarbon fabric laminate

"Armalon" fluorocarbon laminated fabric, a new space-age clothing material to protect personnel manufacturing and handling missile fuels, has been developed by the E. I. du Pont de Nemours & Co., Inc., industrial fabrics development group. This new fabric should also soon find use in lines of industrial safety and protective equipment, including outerwear, gloves, aprons, and the like, suitable for use where flash fires and exposure to extremely corrosive chemicals are hazards.

"Armalon" 97-001A is manufactured under U. S. Patent 2,773,781, issued to the DuPont Co. It consists of aluminized "Teflon" FEP-fluorocarbon film laminated to a fabric made of "Teflon" TFE-fluorocarbon fiber. Government agencies report that tests show that this new type of "Armalon" is more resistant to all chemicals tested, including gaseous fluorine, chlorine trifluoride, and pentaborane, than any suitable fabric constructions yet evaluated.

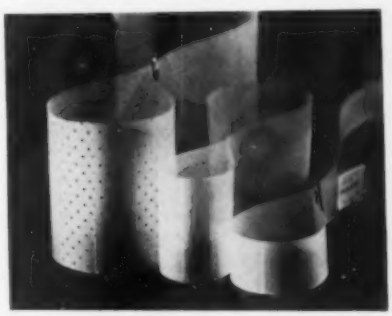
Where protection against flash fires is not required, "Armalon" 97-001 without the reflective aluminized coating is available.

Readers' Service Item 44

Oriented polyester belts

Endless oriented polyester belts for power transmission, conveying, and instrumentation are available from International Ultrasonics, Inc. Since the belts are spliced ultrasonically, joints are 90-100% as strong as the original material.

International offers belts of the Du Pont polyesters Mylar in any length, widths from ¼ to 60 inches, and thickness from one to ten mils or more; and Cronar with



Polyester belts spliced with International's ultrasonic equipment.

ALWAYS AVAILABLE
FLEXOL®
PLASTICIZERS
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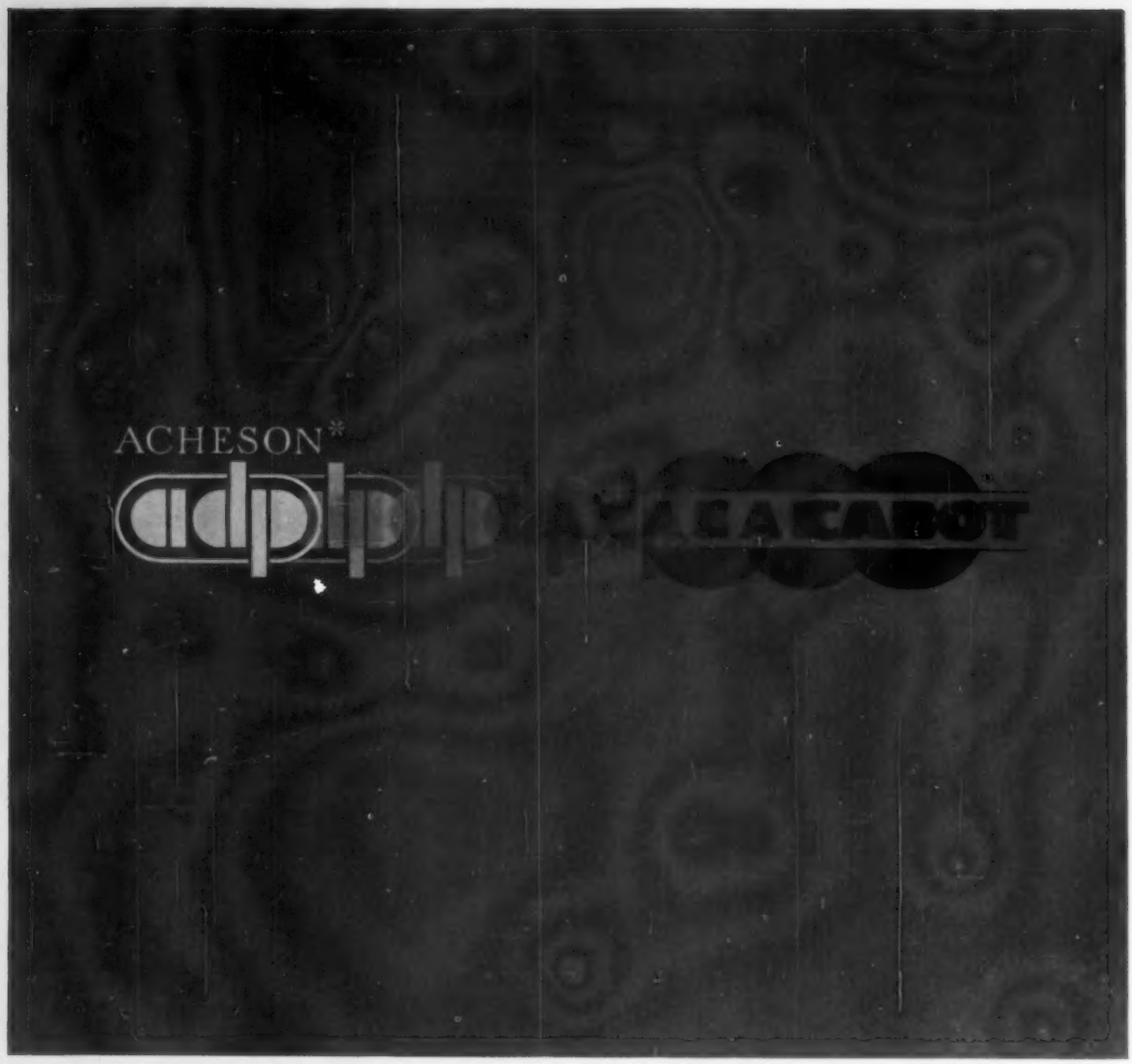
&
DIOP
WHEN AND WHERE YOU NEED IT...
UNION CARBIDE CHEMICALS
For information call Union Carbide Chemicals Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, New York.

For more information check Readers' Service Card No. 155



Acheson Dispersed Pigments Company, one of the most trusted names in the dispersion field, has just been acquired by Cabot Corporation, internationally known as a producer of carbon black and other chemicals for industry. ADP is now the Acheson Dispersed Pigments Division of Cabot Corp., but will continue to mix and disperse all types of pigments, colors, antioxidants, and other additives in the entire range of resins, polymers and liquids.

PICTURE OF A VERY GOOD MOVE-FOR YOU

Acheson Dispersed Pigments has joined Cabot Corporation. The result: *better dispersions for you.*

HERE'S HOW THIS MOVE BENEFITS YOU

- ***No interruption of service.*** The entire operating staff of ADP is being kept so that you can maintain the contacts you have established, and continue to have the benefit of their know-how and experience. As before, you may specify the source of supply for all materials.
- ***Increased service.*** Cabot brings to this new division extensive, world-wide research and development, production, and distribution facilities. Combining these with Acheson's makes it possible to serve your needs better for high quality dispersions.
- ***More and better products from Cabot.*** The acquisition enables Cabot to offer present products in new forms, and to provide altogether new products which will require mixing and dispersing.
- ***Commercial development of CAB-XL®.*** Cabot now will explore commercial possibilities for its crosslinkable polyethylene compounds presently being marketed under the name of CAB-XL® compounds.

Cabot looks forward to helping you with your dispersion problems.

*Only Acheson Dispersed Pigments Company has been acquired by Cabot. Acheson Industries, Inc., a leading supplier of liquid colloidal dispersions, continues to own and operate plants at Port Huron, Michigan, U.S.A., Plymouth, England, and Scheemda, The Netherlands.

ACHESON DISPERSED PIGMENTS DIVISION

CABOT® **CABOT CORPORATION**

125 High Street, Boston 10, Massachusetts, U.S.A.

For more information check Readers' Service Card No. 156

standard perforations and widths from 16 to 70 mm. and thicknesses of 4 or 7.5 mils. The company will also provide belts from strips provided by customers, and having special perforations, magnetic oxide coatings, photographic emulsions, etc. Overlap is a maximum of 0.050 inch ±0.001 inch. Joint thickness is held within 10% of mil thickness of the material, and thickness variation can be held to ±1% on special order.

Readers' Service Item 45

Injection molded, one piece beer case.

Polyethylene beer case

An injection molded, high density polyethylene beer case holding 24 12-ounce beer bottles is in use by Duquesne Brewing Co. The case is molded in one piece of Super Dylan high density polyethylene, produced by Koppers Co., Inc., by the Panelyte division of St. Regis Paper Co.

Made with integral hinges and double lid, the white case with blue lettering is expected to provide four times as much service as the fiberboard container used previously.

Readers' Service Item 46

Cross-section of Smithsonian Institution wall. Gen-A-Lite board is sandwiched between interior wall of concrete block and exterior wall of concrete slab.

Foam board insulates museum

The five-story historical and technical museum now being constructed as part of the Smithsonian Complex in Washington, D. C., is being insulated with Gen-A-Lite foam board. General Foam Plastics Corp. molds and fabricates the insulating board from Koppers' Dylite expandable polystyrene. About 20 truckloads, or 220,000 board feet, will be installed by Bilton Insulation and Supply, Inc.

The Gen-A-Lite board was specified in lieu of the conventional mineral board. According to Bilton, the foam board has almost double the insulation value and can be installed more rapidly because its lightness permits the use of larger boards.

Readers' Service Item 47

Novel desk accessory

A tool that weighs letters, opens letters, and magnifies is now on the market. Contract molded for Morgan Development Laboratories, Inc., by Waterbury Cos., Inc., the tool utilizes two types of Du Pont plastics.

To weigh letters up to three ounces in weight, place the letter in the center of the handle and move the slide weight out until the blade tilts down.

The body and indicator window are of Lucite acrylic, and the spring which holds the metal weight in place is molded of Delrin acetal resin.

Letter weigher, opener, and magnifier.

Readers' Service Item 48

Commercial dishwasher parts

Jackson Products Co. has switched to polypropylene to form the cradles in its latest commercial dishwashing machine. 1056 of the interlocking, four-inch cradles, which support the dishes, are joined to form the conveyor belt of the Model 16Z3 automatic washer.

In this application, Enjay Chemical Co.'s Escon polypropylene replaces vinyl-coated steel and another plastic. Escon will withstand both the chemical effect of the strong detergents and the 190° F. service temperature required in rinsing. Using this resin

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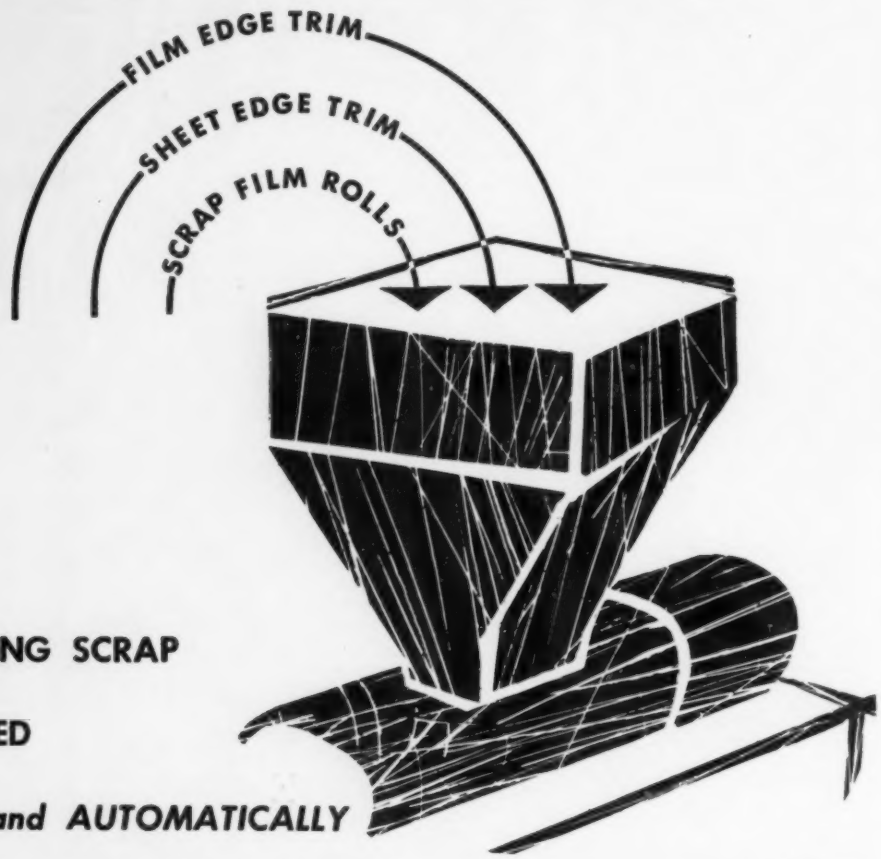
For more information check Readers' Service Card No. 157

handle plastic scrap the modern way!



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Now, you can eliminate old fashioned, costly methods of scrap handling. The completely self-contained Foremost Scrap Recycling System picks up film and sheeting scrap at the source—and returns it directly and automatically to production. The scrap is picked up, ground, blended with virgin at a constant and controlled ratio, and the mixture loaded to the extruder hopper. No need for expensive re-pelletizing or densifying processes. *Plus,* continuous recycling eliminates all danger of contamination.

A Foremost Scrap Recycling System can be customized to your exact requirements from standard component units. The flexibility of this system makes it ideally suitable for even the most unusual scrap problem. Foremost has the modern solution to every scrap need, film—sheeting—vacuum forming—or molding. Write, wire or phone us today.

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For more information check Readers' Service Card No. 158

Interlocking polypropylene dish cradles.

reportedly allowed Jackson to cut the number of parts in the conveyor system by one-third.

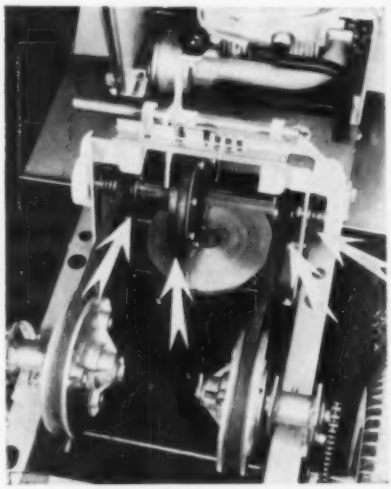
Readers' Service Item 49

Phenolics in lawn mowers

Homelite Division of Textron, Inc. reduced the manufacturing costs and thus the selling price of its "Yard Trac" riding lawn mower-tractor by the use of phenolic instead of metal components, without any compromise in performance. Formerly made of steel or aluminum, the parts now molded of phenolic compounds from the Durez Plastics Division of Hooker Chemical Corp. are the drive wheel hub, two inside and two outside pulley halves, and two hex bearing sleeves.

Homelite's major reasons for replacing metal by phenolics in these parts were the elimination of metal-to-metal contact, which caused fretting corrosion due to steel's high coefficient of friction, and the elimination of rusting, since the mower-tractor is often used on wet grass or stored in damp garages. The lower cost of the phenolic compounds, and the fact that no machining of a part like a drive wheel hub is required, contributes further to cost savings, which in this case is 40% less the cost of the aluminum casting replaced. A still further source of economy is found in the phenolic drive wheel hub, which unlike its metal predecessor, requires no ball bearing and accompanying housing and retaining ring.

Readers' Service Item 50



Phenolic components in Yard Trac. Extreme right arrow is hex bearing sleeve; other arrows (left to right) point to inner pulley half, drive wheel hub, and second pulley half.

Blow molded acrylic hair dryer housing

The shell-like body of the Universal Handy Hannah hair dryer is inexpensively blow molded of pink Implex A high impact acrylic plastic (Rohm & Haas) at half the cost of a similar injection molded part by Plastica, Inc. This firm states that this blow molded application proves the adaptability of the acrylic material to this method of forming. Special blowing techniques were used to attain the unsymmetrical shape.

Acrylic hair dryer housing

Implex acrylic plastic was chosen for its appearance and absence of greasy or oily "feel" as well as strength and shock resistance. ABS materials were considered for this housing but were found to be difficult to blow mold. To meet specifications of the Underwriters Laboratories the inside of the housing was coated with a flame retardant paint. In contrast to some other plastic materials, the acrylic plastic housing did not have to be pretreated to receive this coating. The tube is of clear, reinforced vinyl plastic.

Readers' Service Item 51

Also worth mentioning—

☐ Busse Plastics Co. is offering a disposable white vinyl apron measuring 27 by 42 inches. Made of Impervite vinyl, the apron can be cleaned up with a quick wipe.

Readers' Service Item 52

UNIFORM QUALITY

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PLASTICIZERS

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BATCH AFTER BATCH...FROM

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PHILLIPS 66 MARLEX® PLASTICS

BRIEFS

REPORT 61-3

Increased Demand for Sheet . . . New Data on Extrusion

As many know, the MARLEX thermoforming rush is on. Every day, we're pleased to say, brings something new—boats, tote boxes, shipping containers, decorative panels, assembly line pallets . . . products, parts, and components of all sizes and shapes. Keeping up with this ever-growing demand is going to be a merry business for present and potential extruders of MARLEX sheet. The stepped-up production will undoubtedly result in a few "prosperity" headaches on the production line. When such technical ills occur, we are always willing to lend a hand with possible remedies. In the last five years, our lab boys have extruded around ½ million pounds of MARLEX sheet . . . sparing no effort to become real "wise apples" on the subject.

Appropriately, we have just published a new Technical Information Bulletin on extruding sheet (replacing one published a while back). Discussed are such questions as the relative merits of MARLEX resin types for sheet . . . requirements for extruders, dies, polishing rolls, temperature controls, cooling conveyors, pull rolls, shears, stackers . . . starting-up procedure . . . quality control . . . typical extrusion conditions . . . and properties of MARLEX sheet. In addition, the bulletin contains an *operating guide* covering many of the *problems* encountered during production, their *possible causes*, and *suggested solutions*. We feel that this operating guide should prove useful even to the old hands at MARLEX sheet extrusion . . . if only as a refresher course on past experience.

MARLEX high density polyethylenes and ethylene copolymers are tough, durable plastics . . . yet are easily extruded on equipment originally developed for high impact styrene. While only minor modifications are required to adapt the sheet extrusion equipment to MARLEX, some additional "know-how" is needed. Our new Technical Information Bulletin #1, Extruded Sheet, is a start on acquiring this extra "savvy". It is available to all interested. Just write or call our nearest office.

TR-515, a New High Density Coating Resin

In early June we announced a new extrusion coating resin, TR-515. TR-515 provides a superior polyethylene coating with new toughness, a wider useable temperature range . . . and greater resistance to moisture, oils, greases and the like. As a result of some lengthy developmental testing, we feel we've got a real winner.

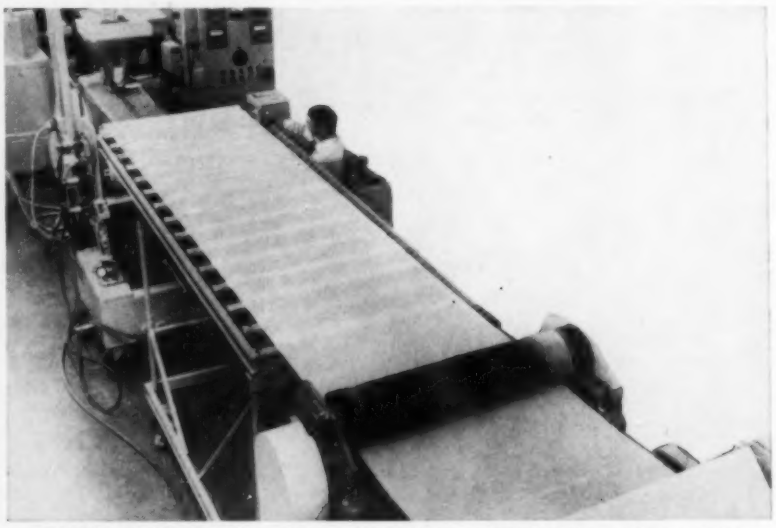
Coating rates with our new TR-515 resin are in excess of 600 feet per minute on standard equipment . . . with thickness less than five pounds per ream being possible. Initially, we expect the big use to be for multiwall bags and pouch paper . . . coated films and foils requiring low moisture transmission and high resistance to greases . . . paperboard products for frozen foods and the like, folding boxes, and corrugated board. Because of the inherent toughness of TR-515, we wouldn't be surprised to see thinner coatings of it replacing thicker coatings of low and medium density poly . . . even in the less critical applications. Write for full details.

By the Seat of the Pants . . . with Imagination

The way in which the furniture industry has taken to MARLEX is heartwarming. Their use of our high density polyethylenes and ethylene copolymers is widespread and well considered. For example, here are some of the furniture items made of MARLEX: highchair trays and footrests . . . interior compartments . . . fabrics of all kinds and textures . . . drawer slides, dowels, and similar hardware . . . decorative panels, covers, and the like . . . and, most significantly, seats, backs, and arm rests for all kinds of chairs from bar stools to stadium seats.

Aside from the volume of this furniture business, what pleases us most is the suitability of the applications to the physical properties of our plastics. In practically every instance our plastics are used where they should be used . . . and used correctly. Our hats are off to the furniture manufacturers, their designers, and plastic fabricators. These fellows, while seemingly thinking about the seat of our collective pants, have used MARLEX both wisely . . . and with imagination.

In the final analysis, the future of MARLEX depends on creative application based on its physical properties—resistances to acids, alkalies, greases, fungi, corrosion, heat, cold . . . its toughness, appearance, molded-in texture and color . . . its ease in molding, thermoforming, extruding, machining, etc. If you want a more complete story here, on the properties and potentials of MARLEX . . . drop us a line, or stop in at any of the offices listed below.



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For more information check Readers' Service Card No. 160

New Literature

For more information check Readers' Service Card (p. 121)

"Kralastic—First in ABS Resins." Naugatuck Chemical division, U.S. Rubber Co. 4 pages. Tabulation of physical, electrical, and chemical properties.

Readers' Service Item 61

"Paraplex P-Series Resins." Rohm & Haas Co. 6 booklets. The booklets supply technical data on Paraplex P-series resins: 446A, 444A, 49, 43 and 43HV, 47, and 13. Included in the data on these plain and acrylic-modified polyester resins are typical properties of liquid form, typical properties of unreinforced castings and glass-reinforced laminates, and other figures and tables. Suggested formulations and curing characteristics are also covered.

Readers' Service Item 62

"Electro-Formed Metal Spray Masks." Form 7625. Conforming Matrix Corp. 8 pages. This folder illustrates and describes masks for multiple color wet paint decoration and protective coating of mass produced parts.

Readers' Service Item 63

"Model BFM-1 Bottle Finisher." Producto Machine Co. 1 page. Illustrations, specifications, and feature of a bottle finisher for use with blow molding equipment.

Readers' Service Item 64

"Heating Cylinder Demand Factors." Injection Molders Supply Co., Inc. 2 charts. Chart A covers cycles from 2-31 seconds, Chart B cycles from 31-120 seconds. They ease calculation of heating cylinder demands in pounds per hour.

Readers' Service Item 65

"Hetrofoam." D-300. Durez Plastics division, Hooker Chemical Corp. 4 pages. Covers properties and potential applications of a rigid, fire-retardant polyurethane foam.

Readers' Service Item 66

"Dapon Diallyl Phthalate Resin for Prepregs." FMC Corp., Dapon Dept. 8 pages. Containing much basic information of prepregs, this bulletin deals with manufacture, molding, properties, military specifications and the general benefits they offer. Specific applications of the use of Dapon prepregs are described and illustrated, and a list of suppliers provided.

Readers' Service Item 67

"Vari-Tex Speed Changers." Bulletin 51B9061B, Case Sizes 4, 5 and 6, 4 pages. Bulletin 51B1042, Case Sizes 2 and 3, 2 pages. Allis-Chalmers Manufacturing Co. Design features, advantages, installation procedures, and information of choice of mechanical, electrical and pneumatic control options are contained in these two bulletins.

Readers' Service Item 68

"Hewflex Pipe Insulation." United Foam Products Co. 2 pages. Properties, installation procedures and advantages of this flexible polyurethane pipe insulation are described.

Readers' Service Item 69

"Scientific Pressure Cast Aluminum Molds and Dies." Scientific Cast Products Corp. 4 pages. This bulletin describes methods by which Scientific, using a single pattern, model or print produces multiple-impression dies or molds at a price well below other methods.

Readers' Service Item 70

"Endless Polyester Belts." Bulletin 2. International Ultrasonics, Inc. 1 page. Features, specification limits and applications of endless belts of DuPont Mylar and Cronar oriented polyester film are explained.

Readers' Service Item 71

"Infra-Red Burners." Data Sheet No. 1B-4a. Pyronics, Inc. 4 pages. Gas-fired infrared burners and infrared heating principles, applications and performance curves are presented to aid evaluation, selection, and specification.

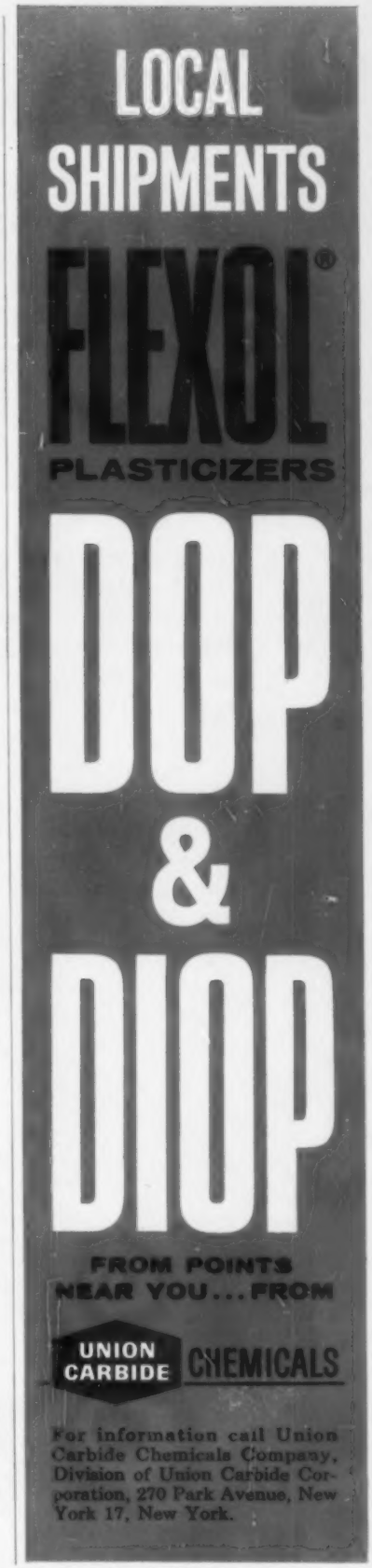
Readers' Service Item 72

"Comparative Chemical Resistance of Textile Fibers." Filtration Fabrics Division, American Machine and Metals, Inc. 4 pages. A chart showing the resistances of all generic fibers to acids, alkalies, salts, solvents and oxidizing agents is included together with the generic name, definition and trade names of man-made fibers.

Readers' Service Item 73

"A New Tracerlab Automatic Process Control Installation." Tracerlab Industrial Div. 8 pages. A recent installation of a Tracerlab Profiling Beta Gauge Automatic Process Control System for the Textileather Division of General Tire & Rubber Co. is described.

Readers' Service Item 74



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Book Reviews

"Rail and Motor Freight Classification Guide for the Plastics Industry." Plastic Classification Guide No. 5. Traffic Committee, Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y. Paper, 8½ by 11 inches, 40 pages. $2.00.

This freight classification chart is intended to serve as a guide in the proper description of articles for transportation by rail and motor truck, and conversely, to serve as a guide in determining the ratings, both by rail and truck, for most articles.

For the convenience of those shipping within the New England area there is a map showing the exact territories covered by the New England Motor Rate Publishing Bureaus. These rates are designated in a separate column, and apply only on intraterritory movements via motor carrier.

"Engineer's Vest-Pocket Book." Ottenheimer Publishers, Inc., 4805 Nelson Ave., Baltimore 15, Md. Cardboard, 2⅜ by 5½ inches, 192 pages. $0.90.

This miniscule reference contains a wealth of engineering data and charts, including such information as the formula for the binomial theorem, the properties of structural steel, the strength of gear teeth, thermal stress, and chemical solubility.

There are an alphabetical index, an index of charts and tables, and 12 marginal indexed headings: mathematics, building, mechanics, heat, hydraulics, pipes, electricity, surveying, costing, mining, chemistry, and miscellaneous data.

"Technical Resources Directory in Plastics." PB 171 036, OTS. U. S. Department of Commerce, Washington 25, D. C. 147 pages. $2.75.

The Department of Defense has published this volume to encourage maximum communication between U. S. military agencies and the plastics industry. It is a compilation of research and engineering information in plastics and reinforced plastics done under the Defense Department-sponsored Plastics Technical Evaluation Center.

The results of a recent PLASTIC survey of all Army, Navy, and Air Force research and development work in plastics are compiled in the directory, which includes a detailed breakdown of the activities of each installation. More than 50 subdivisions of the plastics field are published in the directory, in addition to listings of end items of interest to military installations.

Names of engineers engaged in developing or manufacturing (or both) the plastic items listed; the names, addresses, and telephone numbers of the installations; and telephone extensions of individuals are included.

An alphabetically arranged subject index, enabling the reader to locate the page on which appears the subject of his interest, the military installation in which the activity is carried on, and the personnel involved, appears at the end.

"Industrial Research Laboratories of the United States." National Academy of Sciences, 2101 Constitution Ave., Washington 25, D. C. 700 pages. $12.00.

The new edition of this reference presents detailed information on the activities of 5,420 laboratories in 4,145 industrial firms and other organizations. The name and address of each laboratory is presented, together with the size and make-up of its research staff, and a description of its research activities. A special code indicates the ownership of each laboratory and the availability of its research services. The number of chemists, engineers, and other scientists are presented, while directors and other officials concerned with research are identified by name and position.

In addition to subject and geographic indexes found in earlier editions, this one provides a personal name index of approximately 20,000 individuals involved in research.

"Polystyrene." William C. Teach and George C. Kiessling. Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. Cloth, 5 by 7½ inches. 176 pages. $5.

This addition to the Reinhold Plastics Application Series covers the properties, chemistry and manufacture of the "relatively old" plastic, polystyrene, followed by information on fabrication and applications with a separate chapter on polystyrene foam. Primarily directed to molders, fabricators and end-users of polystyrene, one-half of the book is devoted to the various fabrication methods, including those for polystyrene foam, and applications, and serves as a working guide to all major known procedures.

Under properties, proper emphasis is placed on the fact that laboratory test results do not give exact design data and that the choosing the best material for a given application is still a matter of experience and experimentation. A new approach to the evaluation of the effects of polymerization temperature on molecular weight and new information on the copolymerization of styrene and alpha-methylstyrene are included in the section on chemistry. Brief mention is made of injection molding machines with extruder plasticizing features and of valve gating and sequential impact molding in the section on fabrication. The discussion on blow molding is limited but the potential of this new fabrication method is emphasized.

The chapter on applications is reasonably comprehensive but gives rather limited treatment to polystyrene film, particularly biaxially oriented, which is becoming an important growth field for this plastic. There is noticeable emphasis on the value of impact grades of polystyrene in fabricating products for the appliance, battery, toy, houseware, wall tile, and furniture fields. The separate chapter on polystyrene foam includes considerable detail on pre-expansion methods and equipment, and the properties of this foam. Applications of polystyrene foam in building include quotes from the National Association of Home Builders' booklet on the "NAHB Research House."

The authors place considerable weight on the growth of polystyrene foam in connection with future prospects with special reference to use in building construction. Competition from polyurethane foam may be a factor here, however. It is suggested that improved heat-resistance grades of polystyrene may be developed from isotactic, crystalline types, but here again competition with isotactic polypropylene has to be considered. Appreciation of the future of polystyrene film is indicated.

"Soviet Plastics." English translation of Plasticheskie Massy, No. 7, July 1960, by the Rubber and Plastics Research Association of Great Britain. Published by Rubber and Technical Press Ltd., Gaywood House, Great Peter Street, London, S. W. 1, England. 72 pages. Annual subscription, Canada and U. S. A., 12 issues, $60.

This first issue of a new cover-to-cover translation of the journal of the Soviet plastics industry, "Plasticheskie Massy" in published under a scheme sponsored by the British Department of Scientific and Industrial Research for important Russian journals. The translation is prepared by the Rubber and Plastics Research Association of Great Britain, which two or three years ago began similar translations of "Kauchuk i Rezina" or Soviet Rubber Technology. Publication in both cases is done by Rubber and Technical Press Ltd.

In this first issue of the Russian plastic journal are articles on thermal properties of polypropylene; the stabilization of polyolefins against breakdown by heat, light and oxygen; the thermal breakdown of hardened epoxy resins; on organosilicon polymers; on the effect of machine temperatures on the extrusion of PVC tubing; and on the use of epoxy compounds as stabilizers for PVC, to name but a few. A feature article describes the development of plastic furniture for ships. Other articles cover the determination of the output of single screw extruders and the mechanical testing of plastics.

Each issue will consist of about 72 pages of editorial material on chemistry, production methods and machinery, testing and factory practices and should be of considerable value to American plastic technologists in providing the latest detailed information on the monthly achievements of the Soviet plastics industry.

Patent Digest

Materials

Thermosettable Compositions of Methyl Methacrylate Methacrylic Acid, and Aminoplast Condensate, Process of Making Same, and Articles Obtained. No. 2,978,433. M. D. Hurwitz, Huntingdon Valley, Pa. (to Rohm & Haas Co., Philadelphia, Pa.).

Composition Comprising a Vinylpyridine Polymer and a Hydantoin Formaldehyde Condensation Polymer. No. 2,979,477. E. H. Land, Cambridge, Mass. (to Polaroid Corp., Cambridge, Mass.).

Vinyl Chloride Resins. No. 2,979,480. R. A. Piloni and G. P. Rowland, Jr., Pottstown, Pa. (to Firestone Tire & Rubber Co., Akron, O.).

Manufacture of High Linear Polyesters with Tin Phosphate Catalyst. No. 2,979,483. E. J. Kowolik and J. Lincoln, Putteridge Bury, England (to British Celanese Ltd.).

Manufacture of Phenolic Resins. No. 2,979,484. C. A. Redfarn, London, England (to Walker Extract and Chemical Co. Ltd., Bolton, England).

Suspension Polymerization Process. No. 2,979,487. R. H. Martin, Jr., Springfield, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Suspension Polymerization Process. No. 2,979,491. R. A. Piloni, Pottstown, Pa. (to Firestone Tire & Rubber Co., Akron, O.).

Molding Apparatus. No. 2,980,961. H. Z. Gora, Stratford, Conn. (to Eagle-Picher Co., Cincinnati, O.).

Apparatus for Producing Reinforced Plastic, Resinous or Like Structural Bodies, Forms, Linings and Coatings. No. 2,981,308. F. C. Thompson, Washington, D. C. (to G. F. Shea, Washington, D. C., J. A. Mullen, Grosse Pointe, Mich., and J. M. Neale, Chevy Chase, Md.).

Bleed Back for Injection Molding Cylinders. No. 2,977,634. A. R. Morse, Cleveland, O. (to Injection Molders Supply Co., Cleveland, O.).

Suspension Process for Production of Polyvinyl Chloride. No. 2,985,638. P. W. Trotter, Baton Rouge, La. (to Ethyl Corp., New York, N. Y.).

Method for the Preparation of Fluorocarbons. No. 2,981,761. M. W. Farlow, Wilmington, Del. (to E. I. du Pont de Nemours & Co, Wilmington, Del.).

Curable Aliphatic Polyepoxide Compositions. No. 2,981,701. W. E. St. Clair, Pittsburgh, and R. H Moult, Butler, Pa. (to Koppers Co. Inc.).

Curable Epoxy Phenol Aldehyde-Aliphatic Polyepoxide Compositions. No. 2,981,702. W. E. St. Clair, Pittsburgh, and R. H. Moult, Butler, Pa. (to Koppers Co., Inc.).

Process for Making Polyvinylbutyracetal Resins Which are Capable of Being Cast. No. 2,981,718. J. Heckmaier and A. Stoll. Burghausen, Germany (to Wacher-Chemie G.m.b.H., Munich, Germany).

Polyurethane Plastics. No. 2,981,719. C. Muhlhausen and K. Genski, Leverkusen, Germany (to Farbenfabriken Bayer AG., Leverkusen, Germany, and Mobay Chemical Co., Pittsburgh, Pa.).

Chlorination and Sulfochlorination of Low-Pressure Polyethylene. No. 2,981,720. H. Herzberg and L. Orthner, Frankfurt am Main, Germany (to Farbwerke Hoechst AG., Frankfurt am Main, Germany).

Process for the Production of Vinyl Chloride Polymers by Dispersion Processes in Aqueous Media. No. 2,981,722. E. Enk and H. Reinecke, Burghausen, Upper Bavaria, and E. Kurz, Stockach, near Marktl (Inn) Germany (to Wacher-Chemie G.m.b.H., Munich, Germany).

Suspension Polymerization of Vinyl Chloride. No. 2,981,724. R. S. Holdsworth, Needham, Mass. (to Escambia Chemical Corp., Pace, Fla.).

Stabilized Poly-α-Olefin Compositions. No. 2,980,648. A. Bell, W. M. Gearhart, and J. W. Tamblyn, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Polyureylenes. No. 2,980,651. J. Farago, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Prices, 25c each.
The Editor

Fusible But Insoluble High-Melting, Fiber-Forming Polyesters. No. 2,980,649. J. R. Caldwell and R. Gilkey, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Preparing Polymers Under Vacuum. No. 2,980,650. C. L. Wilson, Sloatsburgh, and H. G. Hammon, Piermont, N. Y. (to Hudson Foam Plastics Corp. Yonkers, N. Y.).

Polymerization Process. No. 2,980,655. J. A. Glass, Akron, and J. F. Jones, Cuyahoga Falls, O. (to B. F. Goodrich Co., New York, N. Y.).

Copolymerization Process. No. 2,980,659. D. R. Witt, Bartlesville, Okla. (to Phillips Petroleum Co.).

Coloured Polymeric Synthetic Material. No. 2,978,290. W. Bossard, Riehen near Basel, and J. Voltz, Basel, Switzerland (to J. R. Geigy AG., Basel, Switzerland).

Equipment

Machine for the Production of Hollow Goods Consisting of Synthetic Resin. No. 2,986,774 to Takeo Kato, Tokyo, Japan.

Injection Molding Machine and Valve Therefor. No. 2,986,776 to Glenn H. Frohring, Newbury Township, Ohio (to Newbury Industries, Inc., Newbury, Ohio).

Machines for the Continuous Cutting of a Bar of Plastic Material. No. 2,986,796 to Giuseppe Mazzoni, Busto Arsizio, Italy.

Process and Apparatus for Forming Tubes. No. 2,987,765 to Mario T. Chichelli, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Inc.).

Apparatus for Shaping High Molecular Weight Thermoplastics. No. 2,987,766 to Frank Porter, Morris Township, N.J. (to Allied Chemical Corp., New York, N.Y.).

Fluid Forming of Plastics. No. 2,987,767 to Charles Edward Berry and Mario T. Cichelli, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Inc.).

Method for Producing Porous Bodies of Thermoplastic Materials. No. 2,987,774 to Ulf Carl Henrik Jacobson, Sundsvall, Sweden (to Isoleringsaktiebolaget W. M. B., Gothenberg, Sweden).

Patent Digest (Cont'd.)

Plastic Cup Mold. No. 2,985,914. William L. Miller, Skokie, Ill. (to Continental Can Co., New York, N.Y.).

Molding Apparatus. No. 2,987,772 to Robert D. Beatty, Jr., Shaker Heights, Ohio (to Richard B. Oviatt, Cleveland, Ohio).

Method and Apparatus for Extruding Plastic Conduit. No. 2,987,768 to Joseph H. Given, Columbus, Ohio (to Plastex Co., Columbus, Ohio).

Applications

Plastic Cartridge Ampoule. No. 2,986,141 to John W. Hart, Albany, N.Y. (to Sterling Drug, Inc., New York, N.Y.).

Plastic Recipe File. No. 2,986,144 to Viola L. Shepard, Clay Center, Kan.

Plastisol Pipe Joint. No. 2,986,411 to Richard H. Anderson, Dover, Ohio (to Robinson Clay Products Co., Akron, Ohio).

Composite Plastic Protective Covering for Power Cables. No. 2,986,486 to Herbert Douglass Short, Toronto, Can. (to Canada Wire and Cable Co. Ltd., Toronto, Can.).

Water-Borne Float for Supporting People. No. 2,986,749 to Thomas J. Webber, Hawthorne, N.Y., and Irwin S. Bitter, Mount Kisco, N.Y.

Inflatable Buoyant Device. No. 2,986,751 to Louis Baren, Chicago, Ill.

Laminated Polyvinyl Chloride Sheets and Method of Making Same. No. 2,987,103 to Michael A. Yakubik, Hudson, Ohio (to Goodyear Tire & Rubber Co., Akron, Ohio).

Inflatable Cushion. No. 2,987,114 to Raphael Klepper, Jacksonville, Fla.

Plastic Cap for Containers. No. 2,987,206 to Jean Grussen, Paris, France.

Reinforced Plastic Article and Structure for Forming the Same. No. 2,987,217 to Daniel J. Reed, Milwaukee, Wis. (to A. O. Smith Corp., Milwaukee, Wis.).

Molded Plastic Pistol Holster. No. 2,987,229 to Armand J. Leclerc, Leominster, Mass. (c/o Ray Plastic Co., Wichendon Springs, Mass.).

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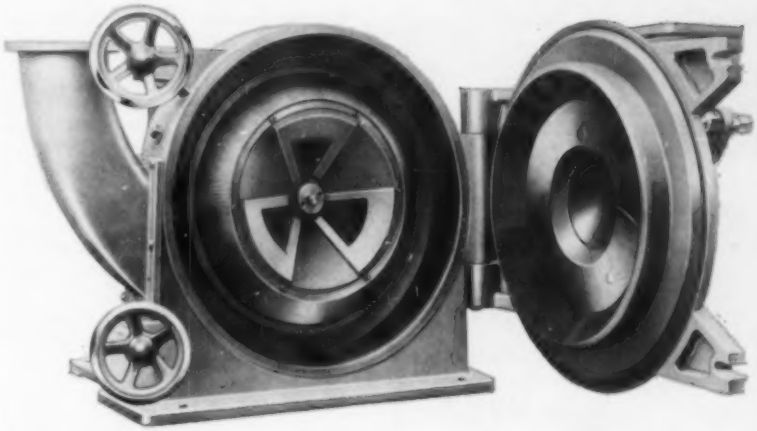

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Article Abstracts

Materials

"Permittivity Characteristics of Alkyds in Relation to their Use in TV Tuners," A. L. Ashton and D. M. Walker, BRIT. PLASTICS, 33, 3, 110 (March 1960).

Alkyds reinforced with Terylene have improved permittivity. Methods for determining permittivity changes and the conditions affecting permittivity are discussed.

"Additional Variables in the Brittleness Temperature Testing of Polyethylene," ASTM BULL., p. 55, No. 248 (Sept. 1960).

A brief note on the shortcomings of ASTM tentative test methods for brittleness.

"Ultraviolet Absorbers Stop Degradation," Dr. Weicksel, CANAD. PLASTICS, p. 47 (Oct.. 1960).

Application data are given to describe a few instances where ultra-violet absorbers can lead to improved product performance.

"Methods for the Practical Determination of Stress Crack Resistance of Different Polyethylene Grades," F. Elbers and F. Fischer, KUNSTSTOFFE, 50, 9, 485 (Sept. 1960).

Stresses necessary to produce stress cracking in various types of polyethylene are described. A simple test is given whereby the molder can arrive at an objective opinion for different materials.

"Characterization of Macromolecular Materials," H. Hellfritz, KUNSTSTOFFE, 50, 9, 502 (Sept. 1960).

It is very important to characterize and classify high molecular substances in order to identify two or more materials as being the same or different. This classification affects tailor-made macromolecules.

"Melt Extractor Moves into New Role —Preplastication," Albert Spaak, MODERN PLASTICS, 38, 2, 107 (Oct. 1960).

Description of a new preplasticizing injection system that can be used to increase production rate and part quality.

"Colormetric Precision Method of Determining End Groups," S. R. Palit, KUNSTSTOFFE, 50, 9, 513 (Sept. 1960).

Using the principle of cationic and anionic soaps, it is possible to develop a simple and accurate color test for high polymers having end groups.

"Testing and Evaluation of Dirt Resisting Properties of PVC Leathercloth and Sheeting," F. Kratschmann, KUNSTSTOFFE, 50, 9, 534 (Sept. 1960).

By application of a suitable dry and hard top coating, good dirt-resistant properties can be obtained.

"Advances in Vinyl Plastics Test Methods," J. B. DeCoste, SPE J., 16, 10, 1129 (Oct. 1960).

A review of the current status of vinyl test methods being developed.

"The ABMA Reinforced Plastics Ablation Program," W. R. Lucas and J. E.

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Kingsbury, MODERN PLASTICS, 38, 2, 135 (Oct. 1960).

Ablation rates are shown to be controlled by environment, as well as by materials and manufacturing techniques.

"Sucrose Acetate Isobutyrate in Cellulose Acetate Plastics," W. M. Gearhart and E. W. Wilson, 16, 10, 1140 (Oct. 1960).

The properties of sucrose acetate isobutyrate. and several of the advantages gained by its use are given.

"Gelation Effect of Diamino and Hydroxyamino Acids on Amino Acids and other Monomers which usually lead to Non-gelling Polyamides," S. A. Szewczyk, IND. PLASTIQUES MOD., 13, 3, 25 (April 1961).

It is shown that films can be cast from solutions of these mixed polyamides in mixtures of light solvents that are flexible, colorless and have good tensile strength. (In French.)

"Improved Classification of Vinyl Resins," R. Braddicks, Jr., and Thomas Van Deren, SPE J., 16, 10, 1144 (Oct. 1960).

A practical method is given for determining processing behaviors of PVC, PVA, and PVA copolymers.

"Tung Oil and Its Derivatives in Polyesters," F. B. Root and R. W. Amidon, MODERN PLASTICS, 38, 2, 144 (Oct. 1960).

A report of work done under contract with the U. S. Department of Agriculture.

"The Aging of Plastics—Part I," P. Dubois and J. Hennicker, PLASTICS (LONDON, 25, 276, 428 (Oct. 1960).

This section considers some of the internal factors affecting aging, and the external factors such as thermal, chemical, and mechanical stress.

"Impact Fatigue Test for Polythene Film," B. S. Glyde, W. A. Holmes-Walker, and K. D. Jeffs, BRIT. PLASTICS, 34, 8, 432 (Aug. 1961).

The test is shown to depend on film thickness, and test conditions.

"Rigid Moltopren, a Polyurethane for Thermal Insulation," F. K. Brochhagen, KUNSTSTOFFE, 51, 5, 246 (May 1961).

The importance of compounding ingredients, especially blowing agents, are discussed.

"Rapid Measurement of the Light Transmission of Plasticized PVC Film," D. A. Smith, BRIT. PLASTICS, 34, 8, 438 (Aug. 1961).

Method and results obtained for quick measurement of light transmission qualities are described.

"The Use of Technical Statistics in Plastics Testing and Standardization," W. Ploch, KUNSTSTOFFE, 51, 5, 252 (May 1961).

The subject is explained by use of two examples.

"Linear and Non-Linear Retardation Behavior of Low-Pressure Polythylene," F. Schweiger, KUNSTSTOFFE, 51, 5, 256 (May 1961).

An explanation of behaviors based on creep test results.

"Quality Insurance of Thermosetting Moldings," E. Motzkus and H. Wallhaufer, KUNSTSTOFFE, 51, 5, 264 (May 1961).

A method is given for ensuring quality in moldings.

"Principles and Methods of Determining Quality in Molding Compounds and Moldings in France," R. Barrat, B. Bossu, P. Dubois, and R. Herou, KUNSTSTOFFE, 51, 8, 432 (Aug. 1961).

Various French test methods are described and evaluated.

Equipment

"A Simple Furnace for the Annealing of Acrylic Resin Tube and Rod," P. C. Lovegrove and L. E. Gill, BRIT. PLASTICS, 34, 9, 482 (Sept. 1961).

Description of the furnace, and representative results obtained.

"Dual Die Extrusion Film Winding Problems Solved with Cantilevered Turret Winder," H. K. Lambert, PLASTICS DESIGN PROCESSING, 1, 3, 21 (Aug. 1961).

(Continued on page 118)

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in January. The last listing appeared in the September issue.

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CALENDAR of COMING EVENTS

November 15
SPE New York Section RETEC. Vinyl Plastics in the Household. Statler-Hilton Hotel, New York, N. Y.

November 17-18
University of New Mexico Section, A. S. M. E. Symposium on Designing for Non-Metallics. University of New Mexico, Albuquerque, N.M.

November 26-December 1
ASME Winter Annual Meeting. Statler-Hilton Hotel, New York, N. Y.

November 28-30
Building Research Institute. 1961 Fall Conferences. Mayflower Hotel, Washington, D. C.

November 29-December 1
U. S. Army Signal Research and Development Laboratory. Wire and Cable Symposium. Berkeley-Carteret Hotel, Asbury Park, N. J.

December 1
SPE Cleveland Section RETEC. Plastics Screw Injection Molding. Sheraton-Cleveland Hotel, Cleveland, O.

January 30-February 2
SPE 18th ANTEC. Penn-Sheraton Hotel, Pittsburgh, Pa.

February 6-8
SPI 17th Reinforced Plastics Division Conference. Edgewater Beach Hotel, Chicago, Ill.

March 6-7
Society of Vacuum Coaters. 5th Annual Technical Conference. Sheraton-Cleveland Hotel, Cleveland, O.

March 20-29
American Chemical Society. 141st National Meeting. Washington, D. C.

April 4-6
SPI 19th Western Section Conference. Hotel del Coronado, Coronado, Calif.

April 17
SPE Philadelphia Section RETEC. Polypropylene's Expanding Position in Plastics. Sheraton Hotel, Philadelphia, Pa.

May 10-11
SPE Newark Section Workshop. Encapsulation: Materials and Techniques. Military Park Hotel, Newark, N. J.

May 28-29
SPI 20th Canadian Section Conference. Chateau Frontenac, Quebec City, Que., Can.

May 19-29
Europlastique 62. Terrace R, Exhibition Park, Paris, France.

July 17-19
Western Packaging Exposition. Brooks Hall, San Francisco, Calif.

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Abstracts of Important Articles (Cont'd.)

Brief review of machinery used by Truex Plastics Corp.

"Developments in Extrusion Machinery: Valved and Vented Extrusion," D. Grant, TRANS. PLASTICS INST., 29, 82, 130 (Aug. 1961).

Comprehensive discussion on the subject.

Applications

"PVC Sheet for Packaging," A. E. Meazey, BRIT. PLASTICS, 34, 8, 428 (Aug. 1961).

Description of compounding ingredients and sheet usage in packaging.

"Modern Anti-Corrision Paints," H. J. Klinger, PLASTE KAUTSCHUK, 8, 2, 106 (Feb. 1961).

The composition, properties and applications are described of approved, anti-corrosion paints and systems in use in East Germany. (In German.)

Domestic Production and Sales of Plastics and Resin Material, June and July, 1961

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of June, and July, 1961. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

	June, 1961		July, 1961	
	Production	Sales	Production	Sales
Cellulose Plastics:				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,726,458	1,695,225	1,386,582	1,511,932
Sheets, 0.003 gage and over	2,687,071	2,681,966	2,139,997	2,084,478
All other sheets, rods, and tubes (including other cellulose plastics)	566,675	600,856	424,268	412,909
Molding and extrusion materials (including cellulose plastics)	7,924,380	7,160,927	6,460,602	5,676,877
Nitrocellulose sheets, rods, and tubes	105,642	92,735	53,970	—
TOTAL	13,046,226	12,231,709	10,465,619	9,686,196
Phenolic and Other Tar-Acid Resins:				
Molding materials	19,072,158	17,543,153	12,432,243	11,712,807
Bonding and adhesive resins for—				
Laminating (except plywood)	5,915,952	3,837,384	4,976,554	3,350,422
Coated and bonded abrasives	1,302,400	1,145,107	808,946	824,106
Friction materials (brake linings, clutch facings, and similar materials)	1,624,503	1,408,834	1,112,863	919,516
Thermal insulation (fiber glass, rock wool)	7,362,459	3,954,554	7,014,559	3,276,981
Plywood	5,403,241	5,026,750	5,394,312	4,718,218
Fibrous and granulated wood	592,310	618,171	379,944	403,696
All other bonding and adhesives uses	5,989,405	4,683,017	4,091,397	4,402,770
Protective-coating resins unmodified and modified except by rosin	1,819,125	1,672,066	1,685,585	1,432,271
Resins for all other uses	3,824,052	3,714,555	2,619,521	2,880,941
TOTAL	52,905,605	43,603,591	40,515,924	33,921,728
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	2,296,410	2,187,750	1,548,137	1,379,972
Paper-treating and paper-coating resins	2,542,097	2,398,111	1,793,033	1,964,096
Bonding and adhesive resins for—				
Laminating	2,803,267	2,227,918	1,984,819	1,128,478
Plywood	8,185,100	7,494,305	6,365,795	6,740,242
All other bonding and adhesive uses	3,587,845	3,858,255	3,190,737	3,016,908
Protective-coating resins, straight and modified	3,333,900	2,232,606	2,540,746	1,706,632
Resins for all other uses, including molding	9,269,991	9,890,024	5,998,148	7,568,567
TOTAL	32,018,610	30,288,969	23,421,417	24,504,895
Styrene Resins:				
Molding and extrusion materials:				
Straight polystyrene	25,480,013	21,356,875	26,960,477	16,908,356
All other	40,043,487	33,502,772	35,377,513	28,860,255
Protective-coatings	6,295,689	5,133,946	5,964,770	4,477,864
Textile and paper treating and coating resins	6,152,936	5,228,174	6,055,461	4,183,280
All other uses	14,887,159	21,842,933	13,118,841	18,777,423
TOTAL	92,859,284	87,064,700	87,477,062	73,207,178
Vinyl and Vinyl Chloride Resins:				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)	—	8,500,151	—	6,769,452
Sheeting (resin content)	—	10,911,244	—	8,867,962
Molding and extrusion (resin content)	—	27,605,651	—	21,376,633
Textile and paper treating and coating (resin content)	—	6,100,393	—	4,387,606
Flooring (resin content)	—	15,258,068	—	12,492,880
Protective coating (resin content)	—	3,561,522	—	3,160,329
All other uses (resin content)	—	9,940,404	—	8,665,219
All other vinyl resins for—				
Adhesives (resin content)	—	5,722,518	—	4,857,352
Protective coatings (resin content)	—	2,658,961	—	2,737,050
All other uses (resin content)	—	11,050,911	—	9,683,184
TOTAL	104,521,274	101,309,823	90,411,190	82,997,667
Coumarone-Indene and Petroleum Polymer Resins	18,645,375	18,738,677	15,905,367	16,609,376
Polyester Resins:				
For reinforced plastics	11,157,176	10,748,600	8,720,820	9,102,786
For all other uses	1,802,224	2,040,849	2,194,249	1,707,211
TOTAL	12,959,400	12,789,449	10,915,069	10,809,997
Polyethylene Resins:				
For film and sheeting	—	48,240,366	—	40,906,943
Molding materials	—	19,903,930	—	20,137,335
Extrusion materials	—	15,368,059	—	13,594,785
For all other uses	—	15,913,415	—	14,806,305
Sales for export	—	27,876,976	—	27,364,417
TOTAL	132,789,992	127,302,746	135,352,007[1]	116,809,785[2]
Polypropylene Resins	7,502,765	5,808,340	7,163,246	5,175,956
Epoxy Resins:				
For protective coatings	—	2,600,073	—	1,775,703
For all other uses	—	3,056,016	—	2,303,388
TOTAL	5,494,935	5,656,089	5,464,381	4,079,091
Silicone Resins	567,774	570,059	—	447,370
Miscellaneous Synthetic Plastics and Resin Materials	25,365,320	22,778,272	21,118,174	19,376,150
GRAND TOTALS	498,666,660	468,142,424	448,209,456	397,615,389

[1] 17.2% produced by the low-pressure process.
[2] 17.9% of sales produced by the low-pressure process.
SOURCE: United States Tariff Commission Chemical Division.

Current Market Prices

Prices in general are f.o.b. works. Ranges indicates variations in grade, quality, quantities, and geographical locations of customers. No guarantee of these prices is made, and spot prices should be obtained by contacting this publication.

Catalysts

Ammonium thiocyanate	lb.	$0.1725 /	$0.26
Peroxide, acetyl, 25% in DMP	lb.	1.75 /	4.00
Benzoyl, dry, 96%	lb.	.88 /	2.00
Wet, 50% paste in TCP	lb.	.89 /	2.25
in silicone fluid	lb.	2.75 /	5.00
55% in BBP	lb.	.89 /	2.25
Caprylyl, liquid, 50% in mineral oil	lb.	4.45 /	5.50
In DOP	lb.	5.00	
Cyclohexanone, 45% paste in DBP	lb.	2.00 /	3.00
Powder, 85%, in DBP	lb.	3.00 /	4.00
p-Chlorobenzoyl, paste, 50%			
In mineral oil	lb.	4.25 /	5.00
In TCP	lb.	5.00	
2,4-Dichlorobenzoyl, 50% in silicone oil	lb.	2.00 /	4.25
40% in silicone oil	lb.	4.25 /	6.00
Di-t-butyl	lb.	1.75 /	4.00
Lauroyl	lb.	1.55 /	3.50
Other peroxides	lb.	1.55 /	5.00

Colorants

Black, std.	lb.	.90 /	4.10
Carbon black	lb.	.0575 /	.87
Paste	lb.	.65 /	.74
Bone blacks	lb.	.155 /	.2775
Colloidal dispersions	lb.	.66 /	1.45
Aqueous	lb.	.115 /	.395
Gel coats	lb.	.61 /	.86
Iron oxide	lb.	.1275 /	.23
Lampblack	lb.	.1225 /	.175
Masterbatch	lb.	.60 /	.63
Paste (for epoxies)	lb.	1.58 /	2.15
(for vinyls)	lb.	.50 /	.66
Paste dispersion	lb.	.85 /	1.90
Paste concentrate	lb.	.82 /	1.20
Pigment dispersion	lb.	.83 /	1.15
Blue, std.	lb.	.90 /	2.75
Concentrate	lb.	.95 /	3.00
Masterbatch	lb.	.85 /	1.13
Pearl	lb.	1.38	
Metallic	lb.	.02	
Paste (for epoxies)	lb.	1.25 /	2.60
(for vinyls)	lb.	.62 /	1.84
Paste dispersion	lb.	.85 /	2.40
Paste concentrate	lb.	.78 /	.80
Phosphorescent	lb.	.24	
Brown, std.	lb.	.87 /	4.00
Copper tinsel	lb.	.10	
Gel coats	lb.	.59 /	1.04
Iron oxide	lb.	.15 /	.24
Metallic bronze	lb.	.02	
Paste (for epoxies)	lb.	1.18 /	1.47
(for vinyls)	lb.	.48 /	1.67
Paste dispersions	lb.	.75 /	1.70
Paste concentrate	lb.	.65 /	2.30
Gold, metallic	lb.	.21	
Paste dispersions	lb.	1.40 /	1.60
Tinsels	lb.	.10	
Gray, gel coat	lb.	.59 /	.84
Paste (for epoxies)	lb.	1.40	
Paste dispersion	lb.	1.45 /	2.20
Green, std.	lb.	.90 /	3.25
Chromic oxide	lb.	.45 /	1.40
Concentrate	lb.	.95 /	3.00
Masterbatch	lb.	1.20 /	1.23
Metallic	lb.	.21	
Paste (for epoxies)	lb.	2.86	
(for vinyls)	lb.	.80 /	1.83
Paste dispersions	lb.	.85 /	2.70
Paste concentrate	lb.	.80 /	2.15
Pearl	lb.	.10	
Phosphorescent	lb.	.24	
Orange, dry	lb.	.49 /	3.50
Gel coat	lb.	.75 /	1.05
Lithopone	lb.	1.63 /	1.86
Paste (for epoxies)	lb.	1.58	
(for vinyls)	lb.	.74 /	4.27
Concentrate	lb.	1.58	
Dispersion	lb.	.55 /	2.80
Purple, pearl	lb.	.10	
Red, std.	lb.	.1425 /	5.00
Cadium lithopone	lb.	1.90 /	2.86
Selenide	lb.	4.60 /	7.15
Concentrate	lb.	2.25 /	2.50
Iron oxide	lb.	.0475 /	.205
Metallic	lb.	.021	
Masterbatch	lb.	.75 /	.88
Paste (for epoxies)	lb.	2.35 /	3.77
(for vinyls)	lb.	1.20 /	3.82
Concentrate	lb.	5.42 /	6.49
Dispersions	lb.	.90 /	3.05
Venetian	lb.	.065 /	.1325
Silver, metallic	lb.	.0165	
Paste (for epoxies)	lb.	1.55	
(for vinyls)	lb.	.89 /	.91
Dispersion	lb.	$0.85 /	$1.45
Concentrate	lb.	1.02	
Tinsels	lb.	.10	
Yellow, std.	lb.	.12 /	3.50
Cadium lithopone	lb.	1.21 /	1.29
Concentrate	lb.	1.00 /	2.50
Gel coat	lb.	.61 /	1.03
Iron oxide	lb.	.1225 /	.1875
Masterbatch	lb.	.90 /	.93
Paste (for epoxies)	lb.	2.15 /	2.55
(for vinyls)	lb.	.58 /	3.70
Concentrate	lb.	.65 /	2.87
Dispersions	lb.	.90 /	2.20
White, std.	lb.	.54 /	4.00
Concentrate	lb.	.70 /	1.25
Gel coat	lb.	.59 /	.84
Masterbatch	lb.	.75 /	.80
Paste (for epoxies)	lb.	1.02	
(for vinyls)	lb.	.48 /	.60
Concentrate	lb.	.705 /	.725
Dispersion	lb.	.70 /	2.00
Pearl	lb.	.10	

Fillers

Aluminum silicate pigments	ton	21.50 /	65.00
Barytes	ton	60.00 /	123.00
Paste concentrate	lb.	.705 /	.725
Calcium carbonate, ppt	ton	30.00 /	187.00
Std.	ton	15.00 /	35.00
China clay	ton	40.00	
Flours	ton	50.00 /	106.00
Flocks, cotton	lb.	.12 /	.30
Rayon	lb.	.50 /	1.25
Nylon	lb.	.35 /	2.75
Mica	lb.	.075 /	4.44
Silica	ton	25.00 /	48.50
Whiting	ton	8.75 /	13.25
Oyster shell	lb.	30.00	
Wollastonite	ton	29.00 /	47.50

Miscellaneous

Anti-Fog	gal.	8.69 /	16.95
Anti-Static	gal.	3.57 /	8.50
(for films)	gal.	8.00 /	8.50
Odorants	lb.	1.25 /	10.00
Purging cmpd. (for injection)	lb.	.40	
Wetting agent (for dry coloring)	gal.	2.50 /	3.20
(for wet operations)	lb.	2.59 /	3.69

Mold Release Agents

Silicone type: Cmpds	lb.	4.70 /	5.20
Aerosols, 20 oz. can		.80 /	1.00
Emulsions	lb.	1.09 /	1.65
Solvent type	lb.	.40 /	4.95
Fluids	lb.	2.74 /	6.00
Stearates: Barium	lb.	.41 /	.46
Calcium	lb.	.39 /	.44
Magnesium	lb.	.42 /	.47
Zinc	lb.	.41 /	.48

Plasticizers

Adipate, Butyl Cellosolve	lb.	.45 /	.47
Dibutoxyethyl	lb.	.425 /	.46
Didecyl	lb.	.265 /	.375
Diisodecyl	lb.	.35 /	.385
Diisobutyl	lb.	.41 /	.44
Diisooctyl	lb.	.36 /	.435
Dioctyl	lb.	.35 /	.385
2-Ethyl hexyl	lb.	.35 /	.435
Isooctylisodecyl	lb.	.40 /	.435
Isooctyl	lb.	.49 /	.535
n-Octyl decyl	lb.	.35 /	.44
Azelate, dioctyl	lb.	.41 /	.49
Di-2-ethyl hexyl	lb.	.40 /	.465
Dibenzoate, Diethylene glycol	lb.	.26 /	.275
Dipropylene glycol	lb.	.23 /	.275
Triethylene glycol	lb.	.60 /	.70
Epoxy, polymeric	lb.	.3225 /	.3525
Monomeric	lb.	.3475 /	.3775
Ester, Fatty Acid	lb.	.3525 /	.3775
Monomeric	lb.	.35 /	.60
Laurate, Butoxyethyl	lb.	.39 /	.40
Oleate, Butyl	lb.	.24 /	.37
Butoxyethyl	lb.	.30 /	.33
Methoxyethyl	lb.	.31 /	.34
Phosphate, Tributyl	lb.	.50 /	.535
Tricresyl	lb.	.325 /	.36
Phthalate, Butyl Cellosolve	lb.	.35 /	.385
Butyl octyl	lb.	.255 /	.30
Cyclohexyl	lb.	.265 /	.305
Isodecyl	lb.	$0.24 /	$0.28
Butoxyethyl	lb.	.365 /	.375
Dibutyl	lb.	.28 /	.325
Dicapryl	lb.	.265 /	.44
Dicyclohexyl	lb.	.48 /	.59
Didecyl	lb.	.27	
Diisodecyl	lb.	.24	.45
Diisooctyl	lb.	.26 /	.445
Dioctyl	lb.	.235 /	.305
Isooctyldecyl	lb.	.24 /	.28
Methoxyethyl	lb.	.355 /	.405
Polyester type	lb.	.34 /	.7125
Polymeric type	lb.	.39 /	.93
High-solvating	lb.	.37 /	.425
Ricinoleate type	lb.	.32 /	.35
Sebacate, Dibenzyl	lb.	.91 /	1.04
Dibutyl	lb.	.655 /	.785
Dioctyl	lb.	.57 /	.6825
Soy Bean oil, epoxized	lb.	.3235 /	.4775
Stearate, Butyl	lb.	.235 /	.395
Butoxyethyl	lb.	.31 /	.32
Epoxized octyl	lb.	.3475 /	.5325
Methoxyethyl	lb.	.32 /	.35
Octyl epoxy	lb.	.3925 /	.447
Tallate, Octyl epoxy	lb.	.3475 /	4.025

Resins, Molding, Casting & Coating

ABS type	lb.	.44 /	1.15
Acetal	lb.	.65 /	.93
Colors	lb.	.74 /	1.24
Acrylic	lb.	.46 /	1.08
Alkyd	lb.	.1325 /	1.20
Allyl (diallyl phthalate)	lb.	.95 /	2.50
Carbonate	lb.	1.30 /	2.25
Cellulosics:			
Cellulose acetate	lb.	.36 /	.68
Reprocessed	lb.	.25 /	.36
Cellulose acetate-butyrate	lb.	.40 /	.81
Reprocessed	lb.	.35 /	.45
Celiulose propionate	lb.	.40 /	.81
Ethyl cellulose	lb.	.67	
Reprocessed	lb.	.30	
Epoxy, liquid	lb.	.60 /	1.41
Solid	lb.	.51 /	1.31
Ethylene copolymers	lb.	.32 /	.95
Fluorocarbons	lb.	3.25 /	11.00
Furane	lb.	.75 /	1.00
Liquid	lb.	.32 /	.44
Melamine	lb.	.57 /	.70
Coating solns.	lb.	.3275 /	.4375
Phenolic	lb.	.207 /	1.12
Coating solns.	lb.	.305 /	.3525
Polyamide	lb.	.62 /	1.26
Coatings	lb.	.61 /	1.51
Graphite-filled	lb.	1.40 /	1.83
Heat-stabilized	lb.	1.09 /	1.55
Molybdenum sulfide-filled	lb.	1.19 /	2.07
Polycarbonate	lb.	1.30 /	2.29
Polyester, powder	lb.	.26 /	2.20
Coating	lb.	.0975 /	.1275
Glass-reinforced	lb.	.41 /	.80
Polyethylene, low-density	lb.	.2375 /	.615
Medium-density	lb.	.2375 /	.6425
High-density	lb.	.275 /	1.59
Polypropylene	lb.	.42 /	1.17
Reprocessed	lb.	.50	
Polystyrene	lb.	.18 /	1.34
Reprocessed	lb.	.15 /	.26
Rubber-modified	lb.	.20 /	.275
Polyurethane	lb.	1.30 /	7.50
Silicones, casting	lb.	7.50 /	11.40
Molding	lb.	2.40 /	3.55
Urea coating solns.	lb.	.205 /	.27
Vinyl, dispersion grade	lb.	.24 /	.325
Copolymers	lb.	.2025 /	.44
Molding	lb.	.185 /	.66
Nitrile rubber blend	lb.	.45 /	.53
Reprocessed	lb.	.19 /	.22
Vinyl-vinylidene copolymer	lb.	.185 /	.32
Vinylidene	lb.	.205 /	6.00
Latex	lb.	.45 /	.52

Solvents

Ketones: Acetate	lb.	.08 /	.22
Methyl isoamyl	lb.	.175 /	.415
Esters: Ethyl acetate	lb.	.125 /	.2675
Isopropyl acetate	lb.	.115 /	.255
n-Butyl acetate	lb.	.145 /	.285
Alcohols: Isobutyl	lb.	.13 /	.27
n-Butyl	lb.	.155 /	.295

Stabilizers

Alkyd tin mercaptide, liq.	lb.	2.50 /	3.15
Barium-cadmium complex:			
Liquid	lb.	.50 /	.58
Solid	lb.	.97 /	1.255
Barium-cadmium laurate	lb.	.87 /	.90
Myristate	lb.	.72 /	.75
Barium-cadmium-zinc complex	lb.	.54 /	.56
Barium-zinc, liquid	lb.	.58 /	.615
Powder	lb.	.375 /	.44
Complex	lb.	.47 /	.50
Cadmium-barium, powder	lb.	.68 /	.895
Chelating agent, liquid	lb.	.57 /	.84
Cadmium-containing	lb.	.84 /	.87
Zinc-containing	lb.	.62 /	.80
Organic complex, liquid	lb.	.57 /	.84
Strontium-zinc laurate	lb.	.72 /	.75
Zinc, liquid	lb.	.48 /	.52

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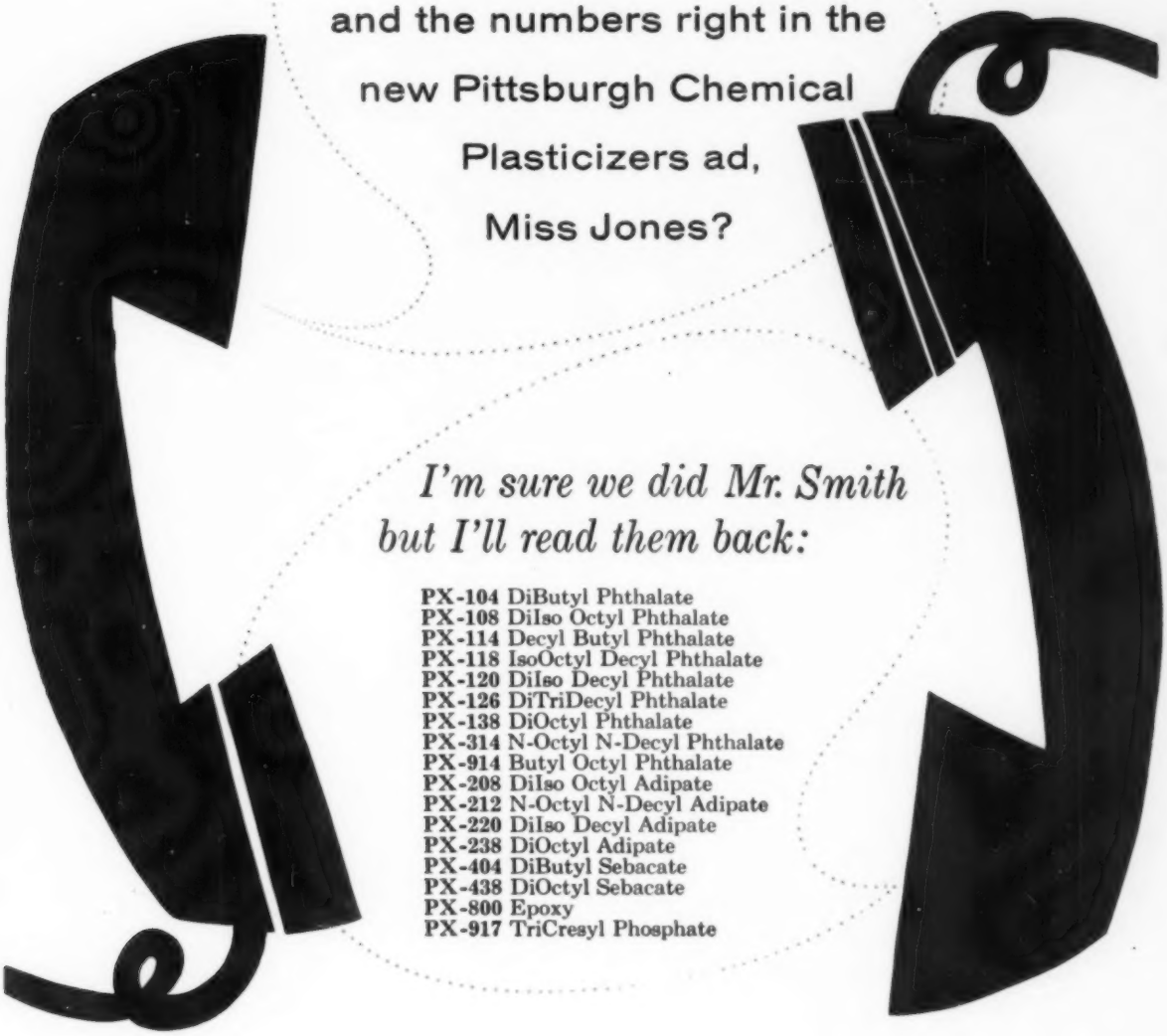
Did we get the names
and the numbers right in the
new Pittsburgh Chemical
Plasticizers ad,
Miss Jones?



I'm sure we did Mr. Smith
but I'll read them back:

PX-104 DiButyl Phthalate
PX-108 DiIso Octyl Phthalate
PX-114 Decyl Butyl Phthalate
PX-118 IsoOctyl Decyl Phthalate
PX-120 DiIso Decyl Phthalate
PX-126 DiTriDecyl Phthalate
PX-138 DiOctyl Phthalate
PX-314 N-Octyl N-Decyl Phthalate
PX-914 Butyl Octyl Phthalate
PX-208 DiIso Octyl Adipate
PX-212 N-Octyl N-Decyl Adipate
PX-220 DiIso Decyl Adipate
PX-238 DiOctyl Adipate
PX-404 DiButyl Sebacate
PX-438 DiOctyl Sebacate
PX-800 Epoxy
PX-917 TriCresyl Phosphate

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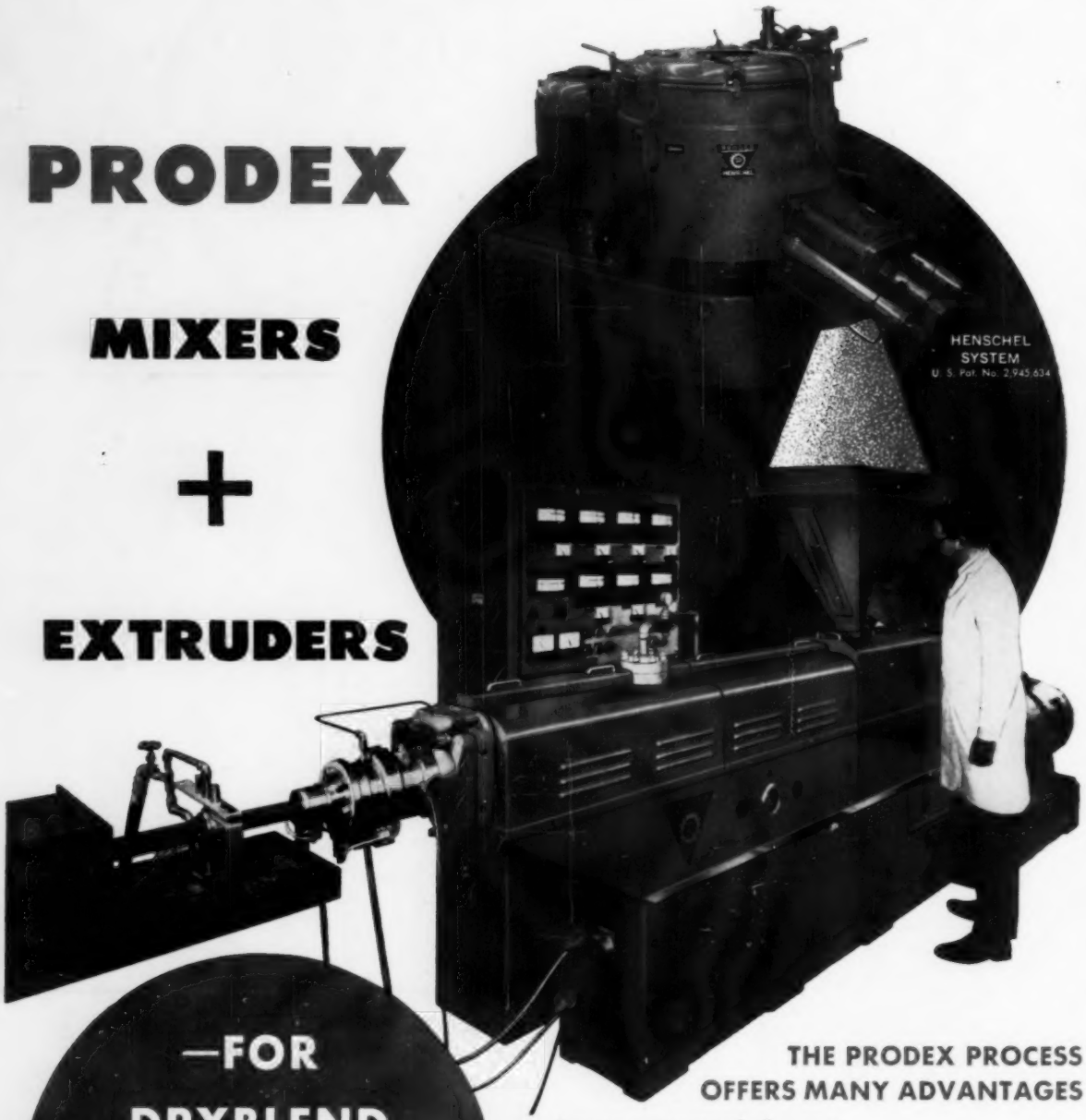

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